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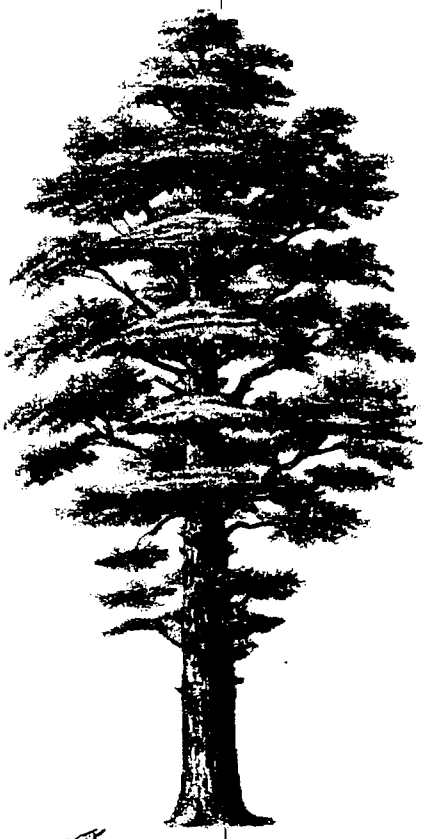
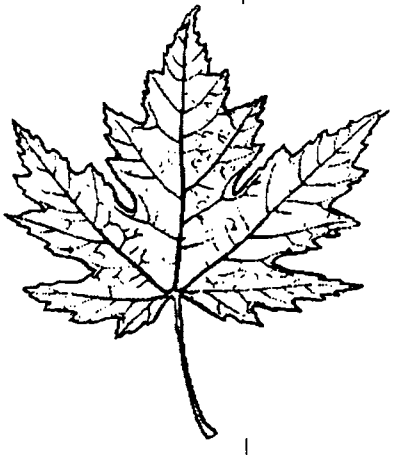
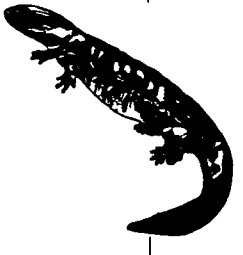


Illinois ForestWatch

Forest Monitoring Manual



Student Manual



Illinois ForestWatch

Forest Monitoring Manual

(Student Manual and Teacher Guide)

by

Robert B. Blair

and

Mark W. Schwartz

Center for Biodiversity
Technical Report 1996(14)

Prepared by:

Center for Biodiversity
Illinois Natural History Survey
607 E. Peabody Drive
Champaign, IL 61820

FINAL REPORT

Prepared for:

Illinois Department of Natural Resources
Research and Planning
Springfield, Illinois

February 1996

Illinois ForestWatch

Forest Monitoring Manual

Student Manual

Illinois Natural History Survey

Illinois Department of Natural Resources

Critical Trends Assessment Project

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February 1996

Table of Contents

Title: Part 1, Protocol 1 -- Characterizing the site and transect.

Question: What are the geographical characteristics of this site and the lands surrounding it?

Goal: To classify the site and its environs in order to compare it with other sites in the state using such characteristics as topography, size, and current land use.

Purpose: You are helping to establish a monitoring site which will be used in a state-wide project to detect long-term environmental change in Illinois. In establishing this particular site, it is necessary to inventory the physical factors that characterize each site so that this site can be grouped with similar sites. Sites within groups based on similar characteristics will then be used to create a statistical sample that will assess widespread changes in habitat quality of Illinois forests.

You can think of a sample as a way to make sure that the information found at one particular site is typical of all similar forest sites in the area. For example, if there are 20 forests in the region and 19 of them are slowly becoming sugar-maple forests but yours is an oak-hickory forest that is not changing, then biologists would conclude that sugar maples are taking over forests in your area. If the scientists only studied your forest, they would conclude that the forests in the area are stable as oak-hickory forests.

Materials:

Pencil
Data Sheet
Geographer's Map Data Sheet
Ruler
Topographic Map of Site
Aerial Photo of Site
Ruler
Information on Land Ownership (County or city plat maps)

Procedure:

1. Read all of the steps in the procedure and assign members in your group the following roles. If you don't have five people in your group, you may take on more than one role. Alternatively, your teacher may wish to assign you to a specific role or two. The roles are:

Facilitator -- makes sure that the group quickly and accurately completes the Protocol by having individuals fulfill their particular tasks.
Recorder -- accurately (and legibly) completes the data sheet.
Geographer -- interprets the topographic map.
Remote Sensing Technician -- interprets the aerial photo.
Outreach Coordinator -- obtains information on ownership of site and permission to conduct a long-term study at the site.

2. Gather the materials listed above.

3. The geographer is responsible for locating your site on a topographic map and gathering some basic information about the area.

Locate your site on the topographic map --

The state of Illinois is divided into counties. All counties are divided into townships and all townships are divided into sections. All townships are square and measure six miles on a side (Figure 1).

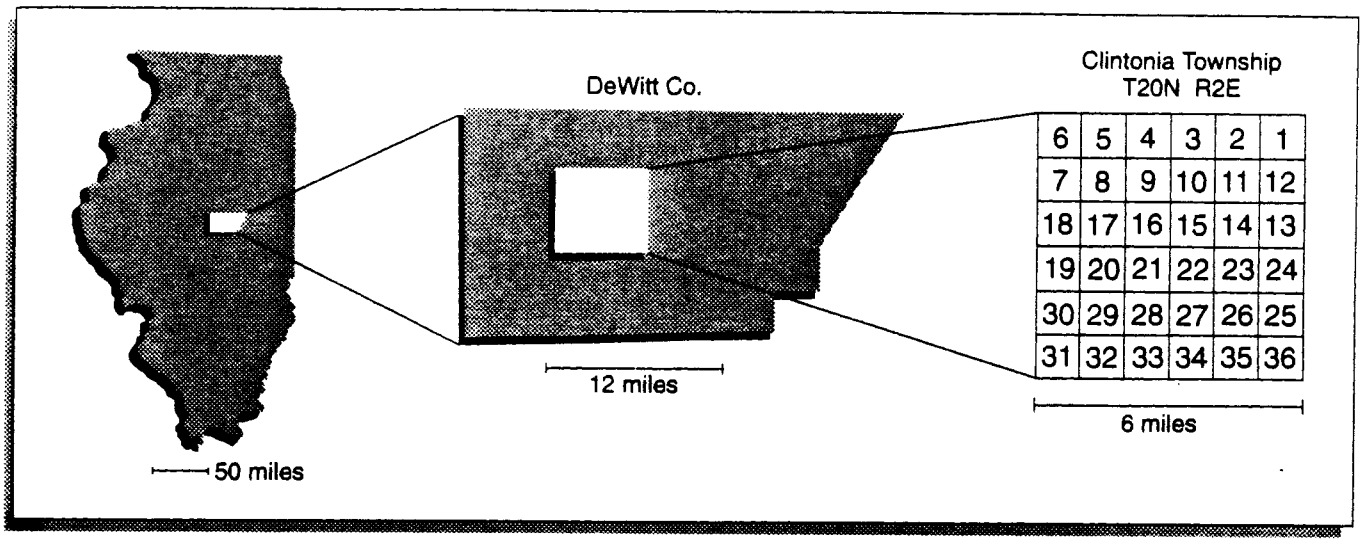


Figure 1. Illinois is divided into counties that are divided into townships that are divided into sections which measure one square mile.

Each township in Illinois has a unique number assigned to it relative to a principle meridian (a line which runs north- south) and a principle baseline (a line which runs east-west) that cross and pass through Centralia, Illinois. Townships are counted north, south, east, and west of those lines. For example, the six by six mile block just to the north and east of the intersection of the meridian and baselines is labeled R1E T1N (for Range 1 East and Township 1 North). The position east-west is called the township's range. The position north-south is called the township's township. A little confusing? The physical township is the six by six mile piece of land and its location north or south is also called the township. Check out Figure 2.

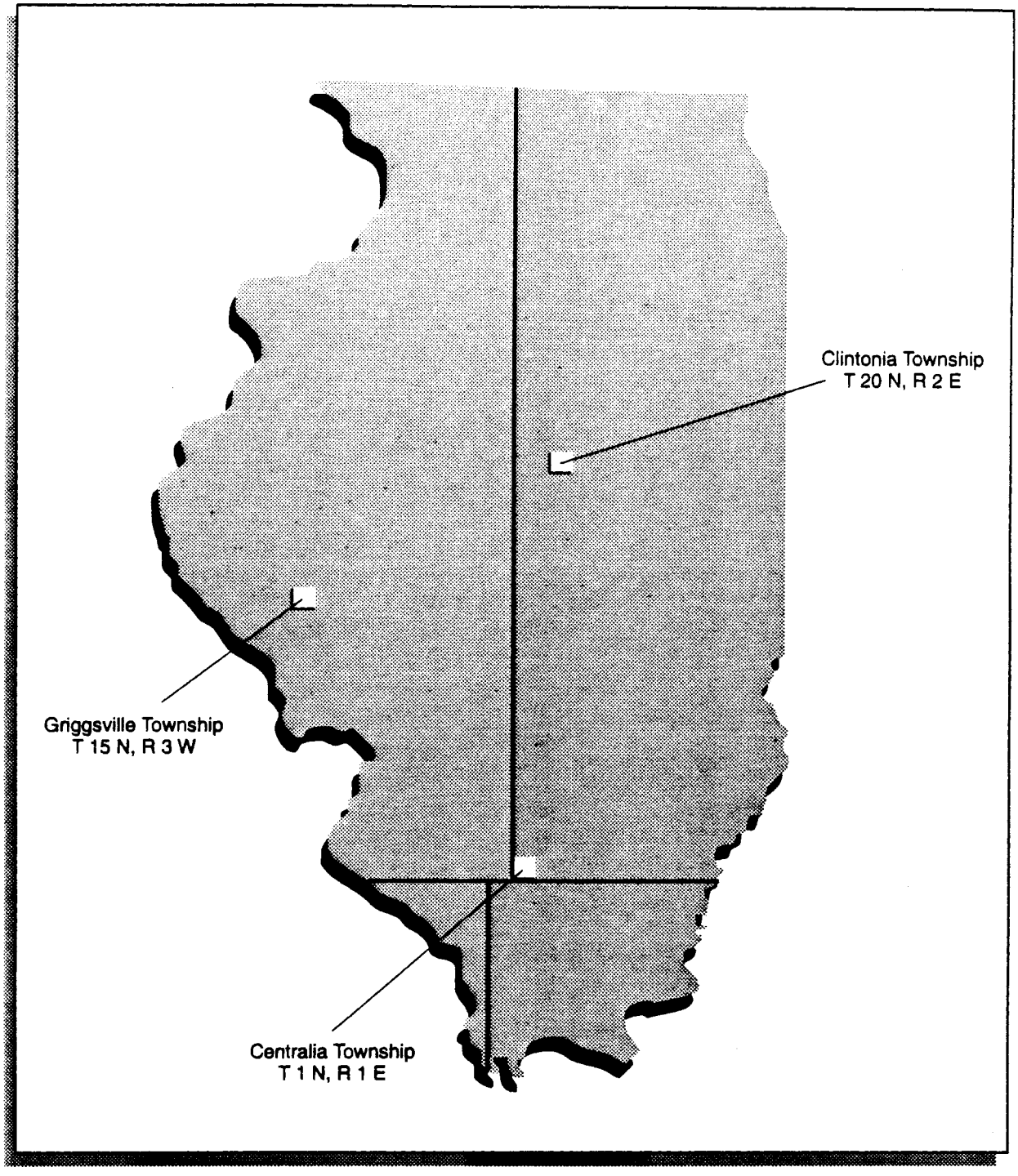


Figure 2. Each township in Illinois is labeled according to its distance from the principle meridian and principle baseline which run through Centralia.

Determine the county, township name, range, township, and section number of your site and record them on the data sheet.

Sketch a map of the site --

Make a sketch of the site -- to scale -- that highlights the main features of the area (which are on the topographic map). Your class will be visiting the site and establishing six permanent transects on it that will be visited by people every year. These transects are basically 100 m long lines in the forest where people will record certain things about the forest such as the type of trees growing there and how big they are. See if you can place 6 lines in the site so that -- at scale -- they are parallel, 15 m apart, and 100 m long. For an example take a look at Figure 3.

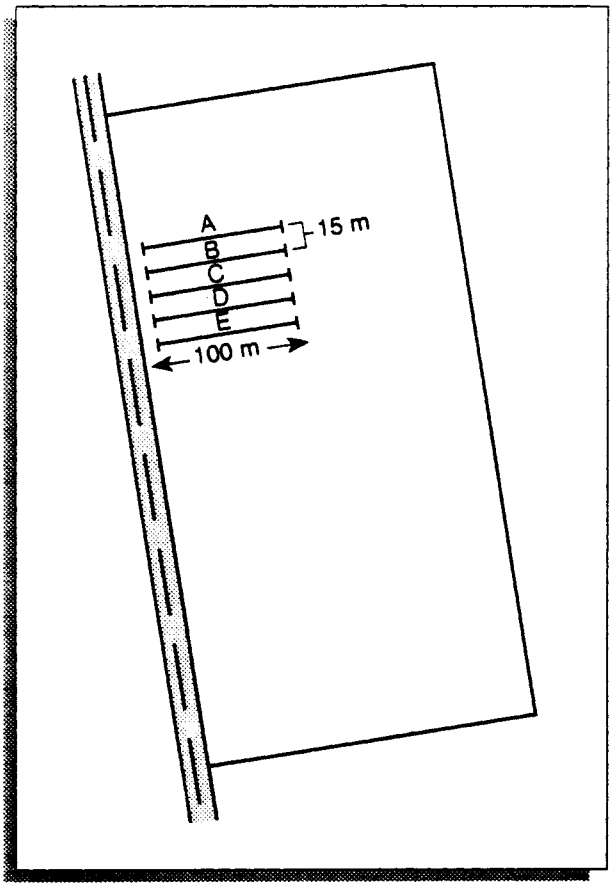


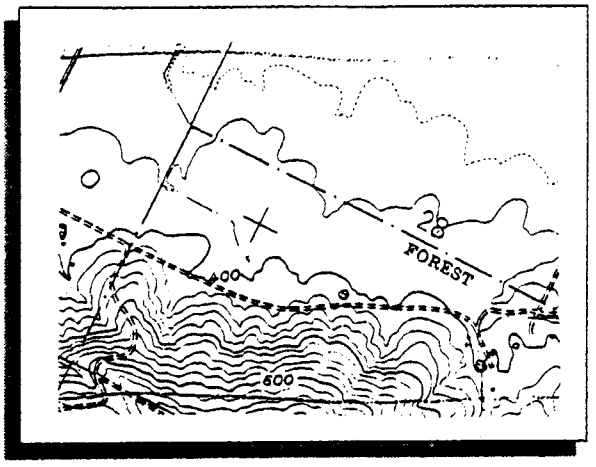
Figure 3. You will establish six parallel transects that are each 100 m long.

Determine topography of the site --

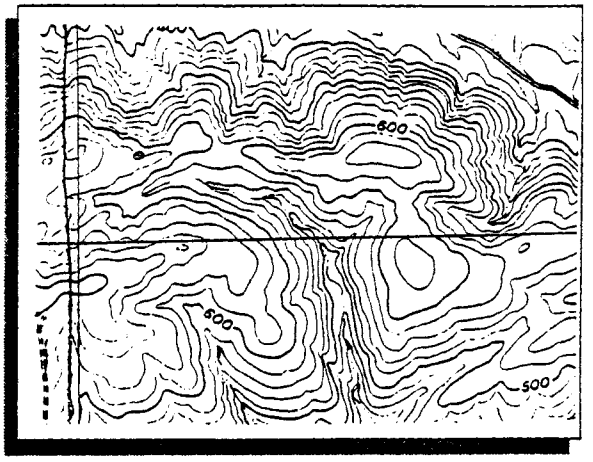
Look at the contour lines on the topographic map. Find the highest and lowest elevations that occur at the site and record them on the data sheet.

See if you can determine the general topography of your site by looking at the pattern of the contour lines. Contour lines run along a certain elevation, say 80 ft. The change in elevation between one contour line and the next is called the 'contour interval' and is usually 40 ft (but check what the contour interval is for your topographic map by looking at the center of the bottom of the map). Is the site generally flat? Is it rolling? Does it have an even slope? Take a look at Figure 4 for examples of contour lines which show these types of topography. Record your decision on the data sheet.

This area has an even slope.



This area is hilly.



This area is flat.

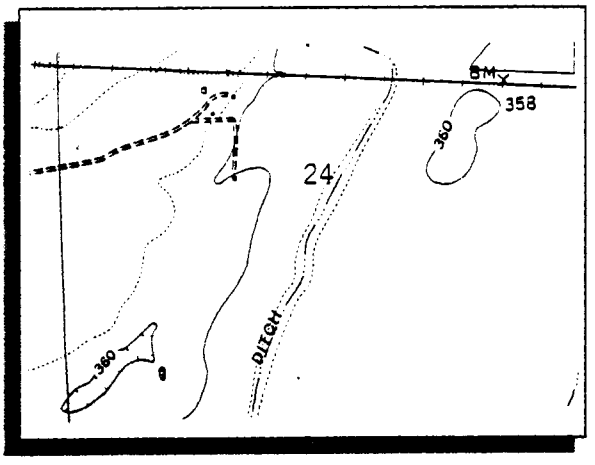


Figure 4. You can tell if a piece of land is flat, rolling, or evenly sloped by looking at the pattern of the contour lines on a topographic map.

4. The Remote Sensing Technician is responsible for locating the site on an aerial photograph and interpreting surrounding land use.

Determine the size of the forest --

Look at the aerial photo of the site and find the site's exact location. If your particular forest has distinct edges (for instance, it may be bordered by cornfields on two sides and houses on the other two sides), determine the size of the forest in square meters by using the scale on the photo and your ruler.

Your forest may be connected to other patches of forests with a thin line of trees that runs along a stream or between field. If this is the case, measure the area of forest that does not include connections to other patches of forest that are less than 50 m wide.

If your forest has curvy edges, you may not be able to determine the area of the forest easily. One simple trick is to draw (or photocopy) a grid onto a clear sheet of acetate (otherwise known as an overhead), lay it over your photo, and count the number of squares that your forest takes up. If you know the area of one square (which you can determine with a ruler and the scale from the photo), then the area covered by the forest is simply the area enclosed by one square multiplied by the total number of squares.

Record the size of the forest patch on the data sheet.

Determine the typical length and width of the forest patch --

In order to have a general measure of the shape of the patch (is it short and wide or long and thin?), measure what you consider the typical length and width of the forest. Take a look at Figure 5 for a few examples. Record these measures on the data sheet.

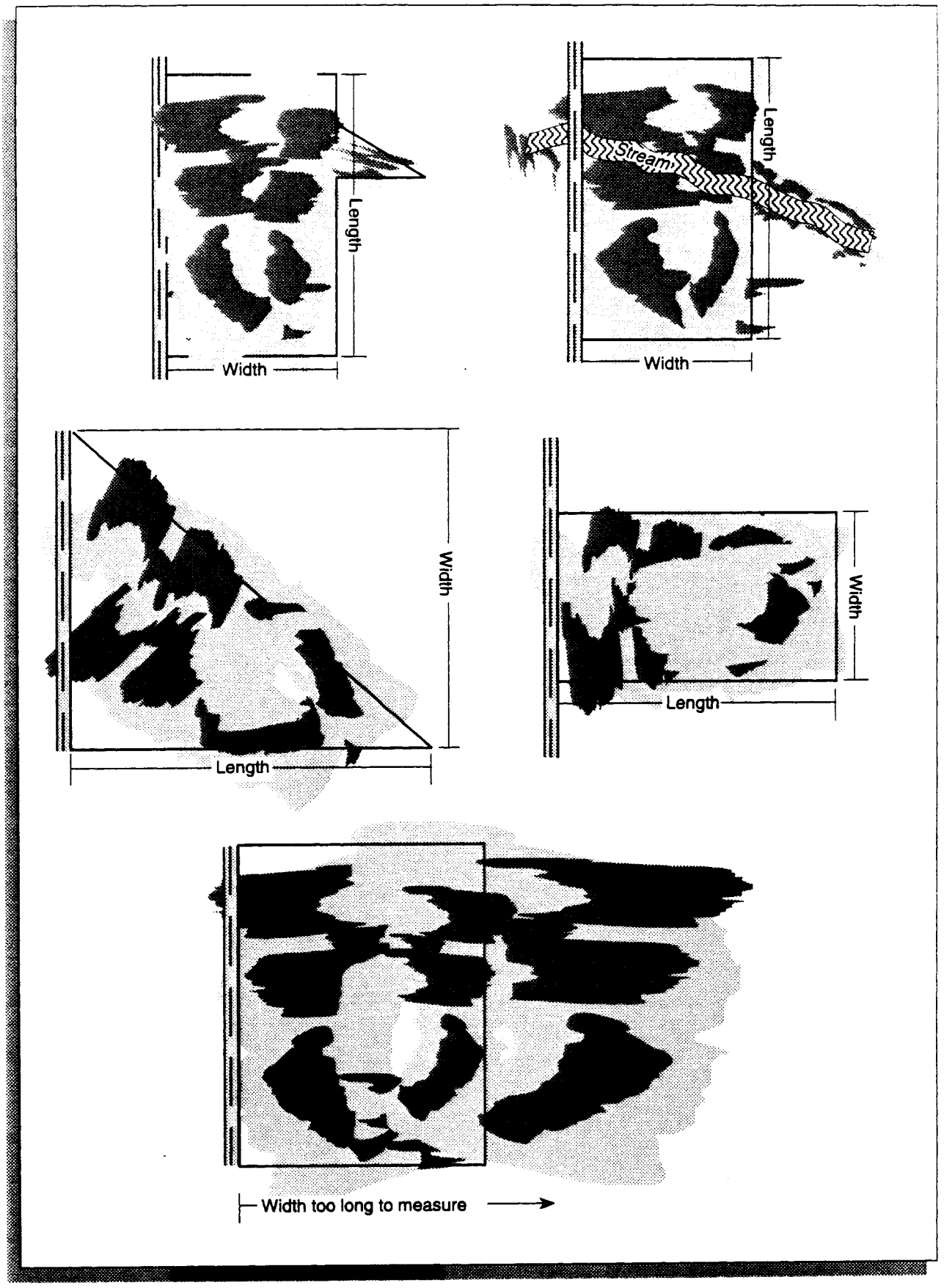


Figure 5. Use these as examples when you are trying to determine the typical length and width of your forest.

Determine the length of the perimeter of the forest patch --

Another way to assess the shape of the patch is to compare its area to the amount of edge that it has. Take a piece of string and outline the forest patch on the photo. Measure the length of the string needed to outline the perimeter of the forest. Finally, convert that length to actual distance based on the scale of the aerial photo. Record that measure on the data sheet

Determine the way land is being used near your site --

Locate the center of the site by comparing the aerial photo to the topographic map and the sketch you created in step 3. Try to find the center of the area you will visit by locating the middle of where you think one of the center transects will be and mark that point. For example, if your site was the one that is sketched in Figure 3, you would place the dot as shown in Figure 6.

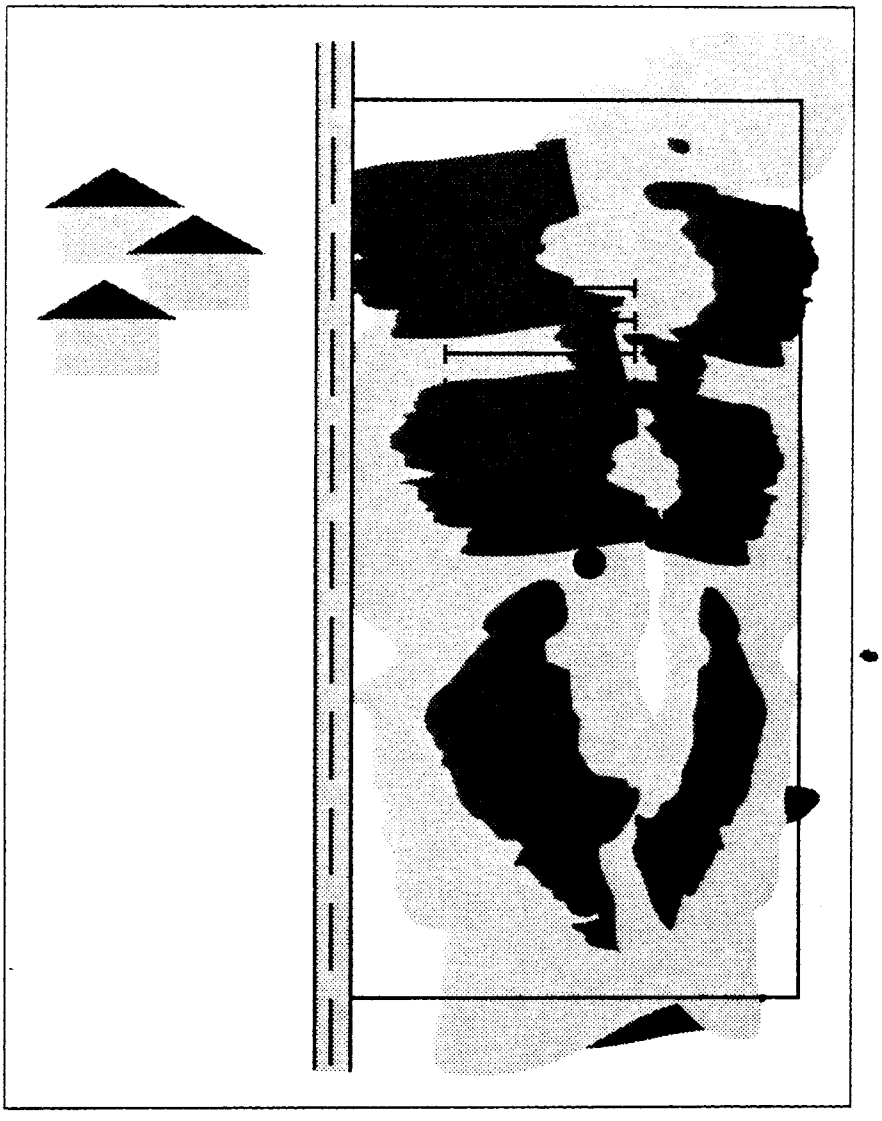


Figure 6. Mark the center of the forest that you plan to visit.

Now use the photo to determine how the land is used 0.5 km and 1 km directly north of your center mark, as well as directly east, south, and west. You may have to use the scale on the photo to find out how long 0.5 km and 1 km are on the photo.

Choose the closest possible land use from those described below:

Forest: Covered with trees and shrubs.
Pasture: Open, grassy lands that are not plowed and are not lawn. Grazing animals such as cows and horses need not be present.
Cropland: Annually plowed agricultural fields such as corn and soybeans.
Residential: Dwellings for one or two families.
Commercial: Non-residential, larger buildings that are not typical of single-family farms.
Other: Some examples are farm buildings, railroad tracks, large apartment buildings, mines, and lakes.

Calculate the Surrounding Land Use Score --

An index is one way to summarize the ways in which the land surrounding your site is being used. The index that you will calculate will average the surrounding land uses and weight it so that land uses which are near your site will have more effect in the index. To calculate this index you apply the following scores to each surrounding land use category that is listed above and add them together.

Surrounding Land Use Scores (SLUS):
Forest = 1
Pasture = 2
Cropland = 3
Residential = 4
Commercial = 5
Other = ? (your call). For instance open water might = 2, apartment buildings may be 4.5

Multiply each score at 0.5 km by 2 (those at 1.0 km by 1) and sum the total:

$$SLUS = 2 (A + B + C + D) + (E + F + G + H)$$

where A, B, C, D, E, F, G, and H are the land use scores for areas A through H on your data sheet.

5. The responsibility of the outreach coordinator is to determine ownership of the land and to gain permission to visit the site.

Determine who owns the land and gain permission to visit the site --

You need to determine who owns the land at the site and to obtain permission to visit it. If it is public land, you should check with the person who manages the area. If it is private land, you will have to contact the owner, explain the project, and receive permission to visit the area. You may use the sample letter to introduce the project to the landowner.

Classify the ownership of the site --

Use Table 1 to fill in the ownership category that best describes the site. For example, a county Forest Preserve District woodland would be classified as 1.3, a stand owned by The Nature Conservancy would be 2.2, and a stand owned by a farmer 2.3.

Table 1. Ownership categories for Illinois ForestWatch sample stations.

1. Public Ownership
    1. Federal
        a. National Forest
        b. US Fish and Wildlife
        c. Military
        d. Other
    2. State
        a. Department of Natural Resources land
            i. Nature Preserve
            ii. other
        b. Other
    3. County
        a. Forest Preserve District
        b. Other
    4. Municipal
2. Private Ownership
    1. Corporate
    2. Non-profit organization
    3. Individual

6. Turn in the tools and data sheets to your teacher. Congratulations, you are done with this Protocol! When you get back to the classroom, you will prepare your data for submission to the Illinois ForestWatch Coordinator.

Task Checklist: Part 1, Protocol 1

Use this checklist to make sure that you have completed all of the tasks in the protocol.

Everyone should...

- ❑ Read all of the steps in the procedure and take on the various roles.
- ❑ Gather the materials needed to complete the protocol.

The Facilitator should...

- ❑ Help everyone to complete their tasks and keep them focused on the tasks.

The Recorder should...

- ❑ Make sure that all of the data is gathered and legibly recorded.

The Geographer should...

- ❑ Locate your site on the topographic map.
- ❑ Sketch a map of the site.
- ❑ Determine topography of the site.

The Remote Sensing Technician should...

- ❑ Determine the size of the forest.
- ❑ Determine the typical length and width of the forest patch.
- ❑ Determine the length of the perimeter of the forest patch.
- ❑ Determine the way land is being used near your site.
- ❑ Calculate the Surrounding Land Use Score.

The Outreach Coordinator should...

- ❑ Determine who owns the land and gain permission to visit the site.
- ❑ Classify the ownership of the site.

After completing the protocol, everyone should...

- ❑ Prepare their data for submission to the ForestWatch Coordinator

Data Sheet: Part 1, Protocol 1

Date	

Name	Role
1.	
2.	
3.	
4.	
5.	

Site Location	
County:	
Township Name:	
Township (ex. T12S):	
Range (ex. R4W):	
Section Number:	

From the Geographer --
Sketch of site and potential location of transects. (On separate sheet).

Elevation of site	In feet
Highest	
Lowest	
Difference	

Topography -- Circle one.		
Flat	Rolling	Even Slope

From the Remote Sensing Technician --

Site Size in square meters	
Typical length of forest patch in m	
Typical width of forest patch in m	
Perimeter Length	

Land use -- Circle one in each table. If it is not forest, pasture, cropland, residential, or commercial, then fill in "other"

E) 1 km N	forest
pasture	cropland
residential	other:
commercial	

A) 0.5 km N	forest
pasture	cropland
residential	other:
commercial	

G) 1 km W	forest
pasture	cropland
residential	other:
commercial	

H) 1 km E	forest
pasture	cropland
residential	other:
commercial	

Site

C) 0.5 km W	forest
pasture	cropland
residential	other:
commercial	

D) 0.5 km E	forest
pasture	cropland
residential	other:
commercial	

B) 0.5 km S	forest
pasture	cropland
residential	other:
commercial	

F) 1 km S	forest
pasture	cropland
residential	other:
commercial	

Site Land-Use Score (SLUS)	

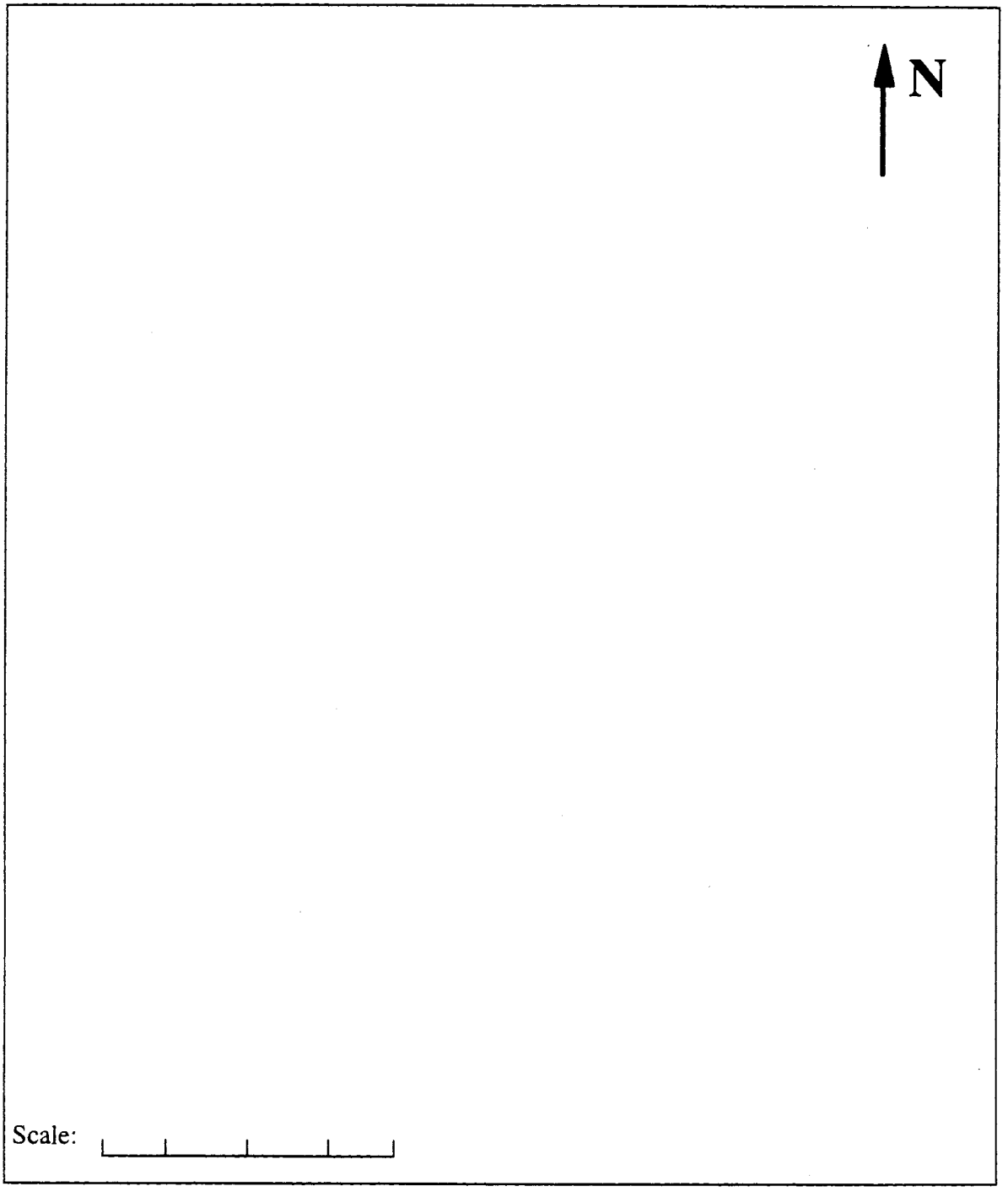
From the Outreach Coordinator --

Ownership and who to contact for permission to visit the site:

Ownership Category	

Geographer's Map Data Sheet: Part 1, Protocol 1

Sketch the site and include possible locations of the six transects, permanent features, and a scale for the map.



Sample Letter: Part 1, Protocol 1

25 March 1998

Jane Landowner
111 Anywhere Lane
Somewhere, Illinois 61820

Dear Jane Landowner:

Our class (or group) is participating in ForestWatch, a program sponsored by the Illinois Department of Natural Resources. ForestWatch is a project which uses volunteers to monitor the condition of forests throughout Illinois. Its overall goal is to keep an eye on the 'health' of forests in the state and to identify any changes in forest condition as they occur. Currently, our class (or group) is looking for a forest to 'adopt'.

We believe that you are the owner of the forest located off of Thisaway Rd in Illinoisville Township (You may need more exact directions than these) and we were wondering if you would let us visit your property on an annual basis so that we may participate in ForestWatch.

Our visits would involve our whole class (or group) of XX people(, our teacher, and XX chaperones). The visits would take a day or two each Spring and would include:
1. Identifying and measuring trees on five 100 m long transects in your woods.
2. Identifying and counting certain plants.
3. Identifying and counting certain species of amphibians and reptiles.
4. Evaluating the condition of certain groups of trees.

We would like to establish six permanent transects in your forest. We would mark these transects with 12 plastic tent stakes anchored in the soil, which would protrude an inch or so from the ground. We would also like to leave behind 12 pieces of 2' x 2' plywood which provide cover for amphibians and reptiles and allow us to have an easy way to sample them. All of our sampling would be non-destructive, which means that none of it involves harming or removing any plants or animals from their habitat.

The information gathered from these visits will only be used to provide general indications of forest health in your region. If you would like, we can tell you what we discover each year. Last of all, you will not be held liable for the safety of any of the people in our class (group) when they visit your property. If you are interested in the program, please let us know. We will be glad to provide you with even more information about the project. We will be calling you within a few days to discuss this idea with you further.

Sincerely,

Mrs. Knowitall's 10th Grade Biology Class
Illinoisville High School
1450 Higher Education Lane
Illinoisville, IL 61820
(217) 555-1212

Title: Part 1, Protocol 2 -- Establishing a long-term monitoring transect.

Question: How is the biological diversity in Illinois' forests changing?

Goal: To establish a permanent transect on which to base long-term monitoring of biological diversity in a specific forest in Illinois.

Purpose: In order to maintain high quality natural habitats and healthy wildlife populations, we need to assess the effects of various human activities on the environment. This assessment, however, requires monitoring -- the collection of information over several years from many different sites -- so that biologists can identify widespread, long-term changes in the environment. This monitoring may focus on trends in particular groups, such as birds or insects, or on the constantly changing conditions of habitats. By doing this Protocol, you will establish a permanent line -- called a transect -- in a forest. This transect will be visited by people at least once a year to collect data that can be used by biologists to monitor changes in the environment and make this assessment.

Materials: (for each group)

110 m long rope, knotted at 10 m intervals (or 100 m measuring tape)
2 long, plastic tent-stakes
Mallet
2 Aluminum Tags
Compass
Topographic Map of Site
Soil Color Card
Small Amount of Water
Trowel
Pencil
Clipboard
Data Sheet

Procedure:

1. Read all of the steps in the procedure and assign members in your group the following roles. If you don't have five people in your group, you may take on more than one role. Alternatively, your teacher may wish to assign you to a specific role or two. The roles are:

Facilitator -- makes sure that the group quickly and accurately completes the Protocol by having individuals fulfill their particular tasks.
Recorder -- accurately (and legibly) completes the data sheet, sketches profile of the transect.
Orienteer -- uses a compass and map to insure that the transect is parallel to other transects being established by your class.
Surveyor -- makes sure the transect is straight and 100 m long.
Soil Technician -- anchors and tags the tent stakes which permanently mark each end of the transect, evaluates soil color and texture.

2. Gather the materials listed above for your group and follow the directions provided by your teacher for determining the general location of your transect. Each transect will be 15 m from its nearest neighbor, begin at the edge of the forest, and follow a roughly perpendicular path into the forest. Take a look at Figure 1.

Locate the end point of the transect --

Run the 100 m long rope (or measuring tape) from the starting point of the transect to the ending point. If your individual step isn't exactly 1 m long, then you may have to move forward or backward so that your transect is as long as the rope, exactly 100 m long. Tap the second metal stake into the ground with the sledge hammer.

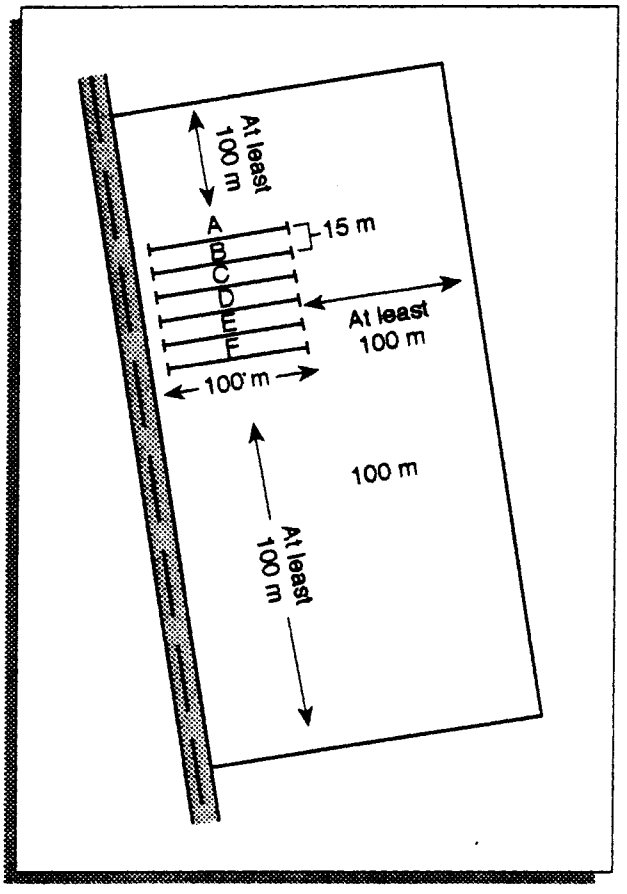


Figure 1. The six transects will be 100 m long and 15 m apart.

3. The orienteer and surveyor are responsible for locating the beginning and end of the transect.

Locate the starting point of the transect --

The starting point of your transect should be at the interior edge of the crown of the canopy tree that is closest to the forest edge. This means that you should find a large tree in the general area where your transect should start, look up at its branches, and walk into the forest until you are standing directly under the last of its branches(Figure 2).

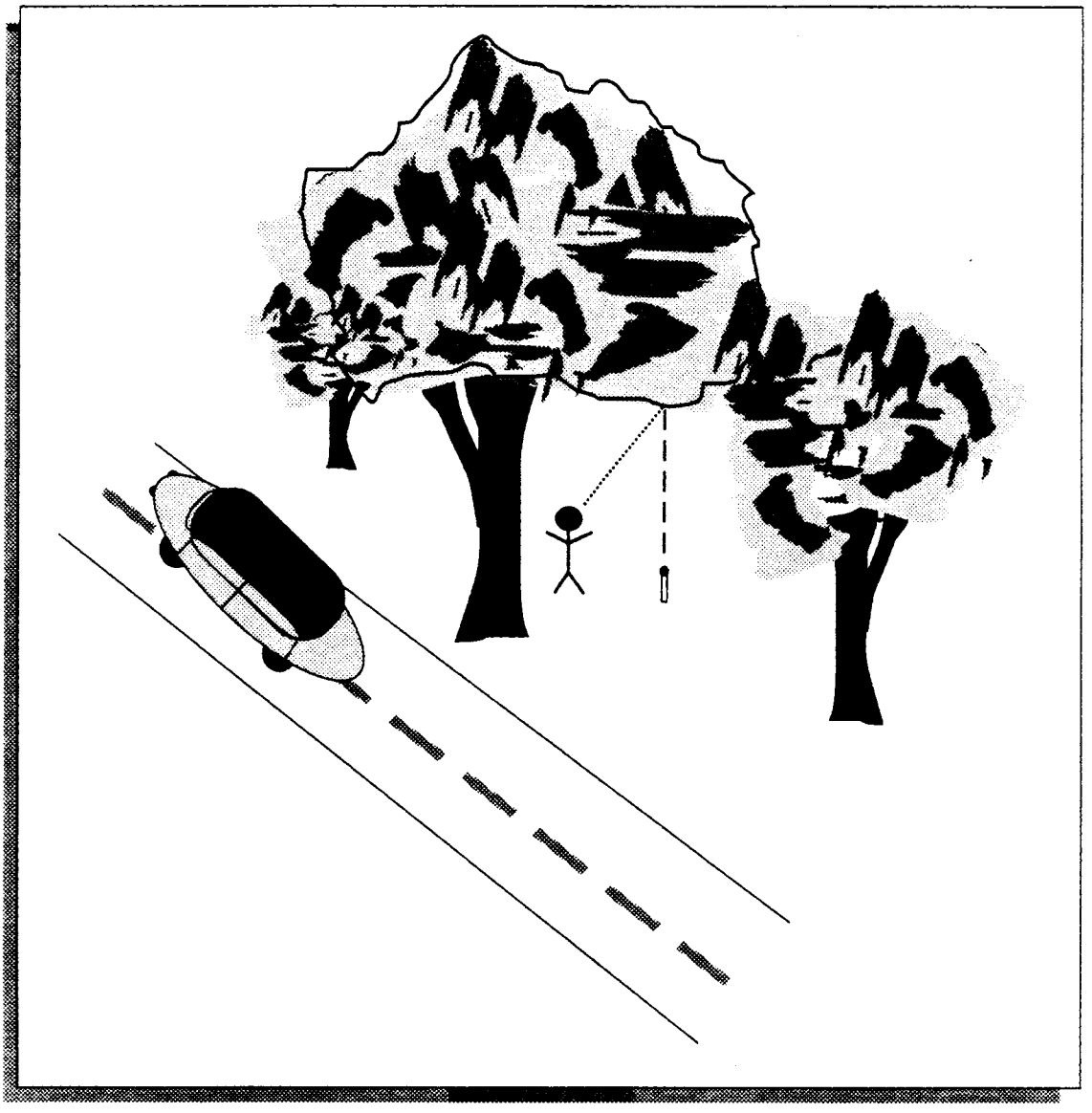


Figure 2. The transect should start a little ways into the forest -- at the edge of the crown of the first large tree that reaches the canopy.

Use the hammer to lightly tap one of the metal stakes into the ground at the starting point of the transect. Pick a spot which is easy to find but which is also out of the way so that the stake will not cause problems such as tripping unsuspecting hikers or jamming roadside lawn-mowers. Don't pound the stake all of the way into the ground just yet! You may have to move it if this exact point does not work out.

Determine the direction the transect will follow --

Use the compass and the bearing provided by your teacher to determine the direction the transect will follow. For example, if your forest site is similar to that in Figure 1, you might be told to take a bearing of 50°. This means that you twist the ring on your compass so that the number 50 is lined up with the arrow at the top of the compass base. You then hold the compass so that the red part of the

needle points to N (0°) (Remember...the needle in a compass points North!). You then face the direction the compass base points, pick out a landmark in that direction, and walk straight to it for 100 paces. Take a look at Figure 3.

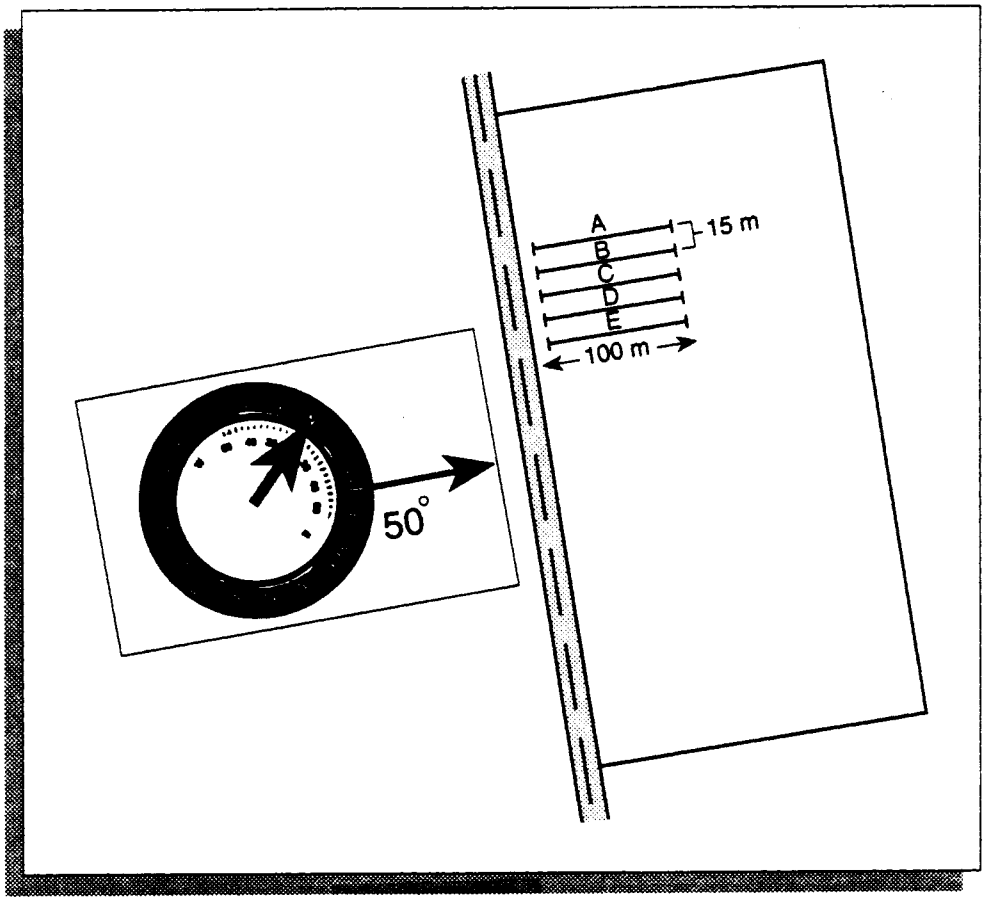


Figure 3. You use a compass by lining up the needle (which points North) with the N and walking in the direction of a bearing (which may range from 0° to 360°). Make sure that you stay on that bearing by picking out a landmark on the horizon and walking towards that landmark.

Locate the end point of the transect --

Run the 100 m long rope (or measuring tape) from the starting point of the transect to the ending point. If your individual step isn't exactly 1 m long, then you may have to move forward or backward so that your transect is as long as the rope, exactly 100 m long. Tap the second metal stake into the ground with the sledge hammer.

If you are certain that the two stakes are in good places -- i.e. easy to locate but not in the way -- put on your safety glasses and pound them into the ground so

that they are firmly anchored. Finally, mark the stakes with metal tags which identify the site with township name; township and range numbers; and the transect letter (A, B, C, D, E or F) and whether the stake is the "Beginning" or "End" of the transect.

Draw a map so that others may find the transect stakes --

Make extensive notes on the data sheet on how to locate the stakes at the beginning and end of the transect. Make sure you use landmarks that won't change over time such as land forms, streams, rocks and possibly large trees. Don't use ephemeral landmarks such as a bird's nest or vines which may not last from season to season.

Surveyors use a technique called triangulation to locate a specific point relative to three other significant features in a landscape. Triangulation relies on the idea that if you know the direction that you should head from three features, the three directions will converge on a single point. See Figure 4. You should use this technique as well to firmly establish the location of the stakes that mark your transect.

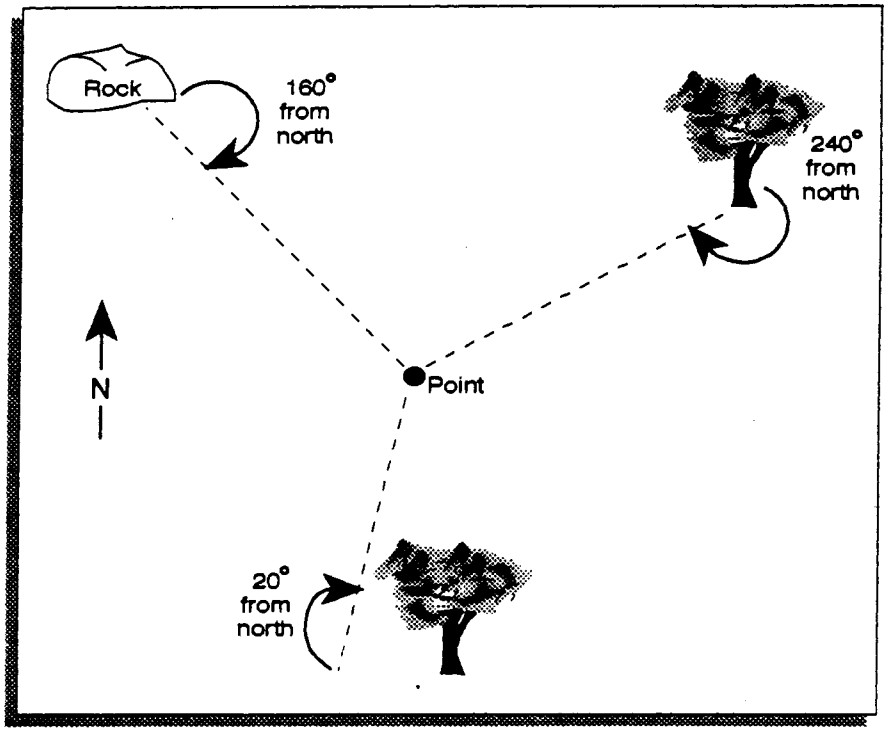


Figure 4. You can locate any point in a plane if you know three other points and the bearings you need to take from them to reach the point.

Stand at the stake that marks the beginning of the transect. Pick out at least three features of the landscape which are distinct enough for a stranger to recognize and are fairly close to the stake. For example, you may pick a log that crosses a stream, a tree with two trunks, and a boulder.

Pick one of these features (a tree, for example) and determine the compass heading you would have to walk from the stake to run into it. You can do this by pointing the direction arrow on the base of the compass at the tree and twisting the dial until the needle lines up with North. The compass heading will be the number of degrees right below the direction arrow on the compass. Check out Figure 5.

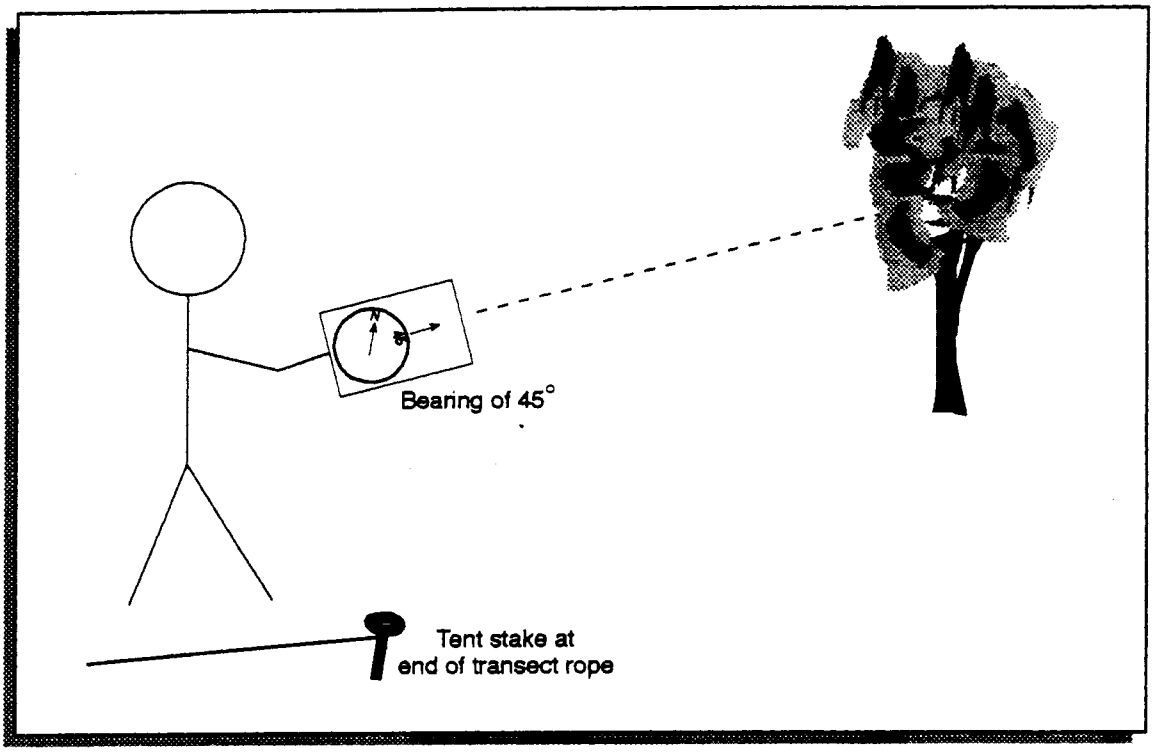


Figure 5. The direction arrow on a compass is the painted one on the base of the compass -- it may have the words "Read Bearing Here" on it. You usually do not follow the needle because it always points North.

Now, pace the distance to the tree. On your map, you should sketch the feature, the compass heading, and the distance in number of paces. Repeat this for at least two other features for that stake.

Now, map the location of the stake that marks the end of the transect. Use at least three distinct features.

Draw a profile of the transect --

Sketch a profile of your transect. Is it flat? Does it slope from one end to the other? Does it peak in the middle? Figure 6 shows some examples.

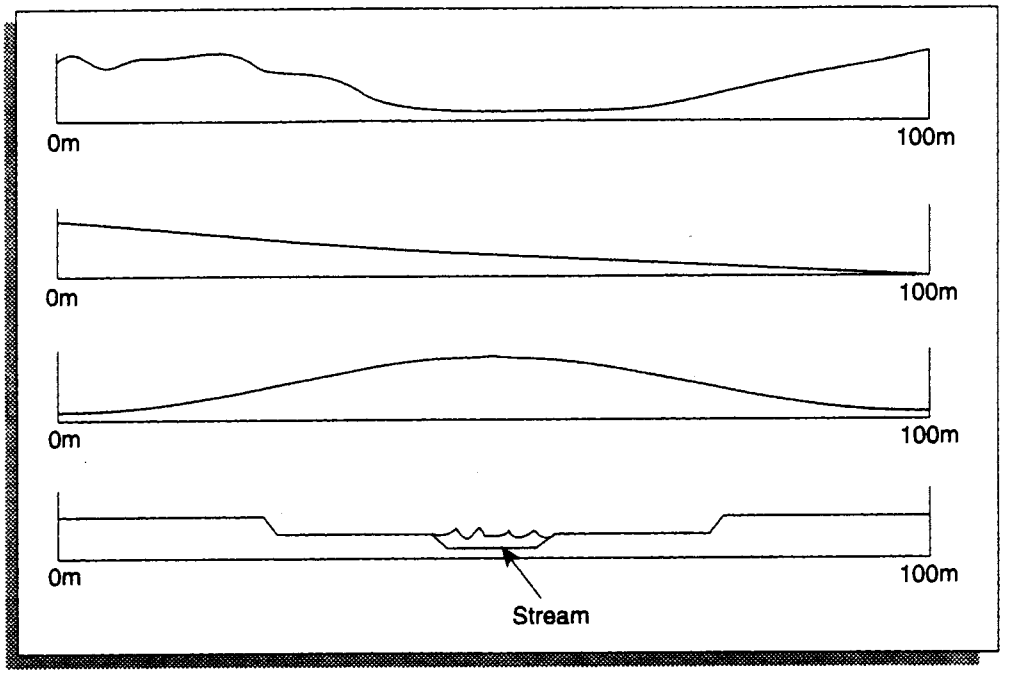


Figure 6. A profile shows how the elevation changes along your transect. You can think of it as a "cut-away" view.

4. The soil technician is responsible for analyzing the color, grain size, and basic composition of the soil.

Sample the soil of your transect at the 0, 50, and 100 m points. At each point, clear away the duff (the leafy layer) and scoop up a handful of soil.

What color is the soil? Compare its color to those on the 'soil color card' and choose the color that is the closest match.

What is the grain size of the soil? Are the individual pieces closest in size to marbles, grains of rice, bb's or sand on sand paper?

Does the soil have any organic matter in it such as small sticks or broken up pieces of leaves?

Wet your handful of soil.

Does it feel grainy or gritty? If so, it contains sand.

Is it silky like wet talcum powder? If so, it contains silt.

Is it sticky and self-supporting? If so, it contains clay.

Your soil may be a mix of one, two, or all three of the above.

Record your answers.

5. Turn in your tools and data sheet to your teacher. Congratulations, you are done with this Protocol! Be ready to prepare your data for submission to the Illinois ForestWatch coordinator.

Task Checklist: Part 1, Protocol 2

Use this checklist to make sure that you have completed all of the tasks in the protocol.

Everyone should...

- ❑ Read all of the steps in the procedure and take on the various roles.
- ❑ Gather the materials needed to complete the protocol.

The Facilitator should...

- ❑ Help everyone to complete their tasks and keep them focused on the tasks.

The Recorder should...

- ❑ Make sure that all of the data is gathered and legibly recorded.

The Orienteer and Surveyor should...

- ❑ Locate the starting point of the transect.
- ❑ Determine the direction the transect will follow.
- ❑ Locate the end point of the transect.
- ❑ Draw a map so that others may find the transect stakes.
- ❑ Draw a profile of the transect.

The Soil Technician should sample the soil of your transect at the...

- ❑ 0 m point.
- ❑ 50 m point.
- ❑ 100 m point.

After completing the protocol, everyone should...

- ❑ Prepare their data for submission to the ForestWatch Coordinator

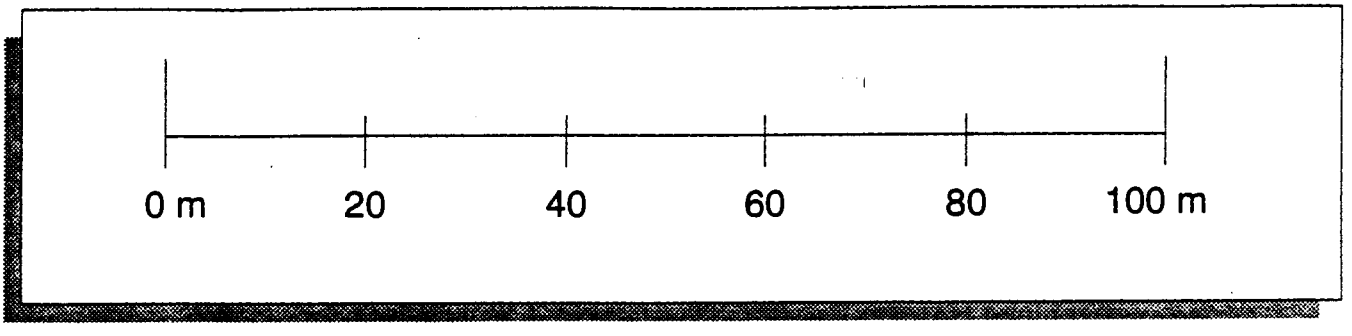
Data Sheet: Part 1, Protocol 2

Date	

Name	Role
1.	
2.	
3.	
4.	
5.	

Site Location	
County:	
Township Name:	
Township (ex. 12S):	
Range (ex. 4W):	
Section Number:	
Transect Letter	
Compass Bearing	

Profile of the transect.



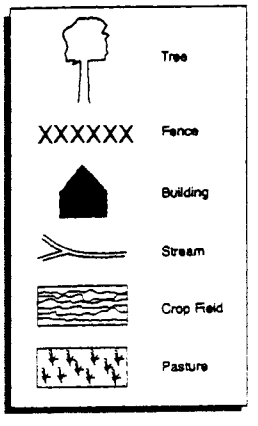
Fill out the table below to describe the soil color and texture at the 0, 50, and 100 m points along the transect. Use only those choices from the soil color card for color; marbles, rice, bb's, or sand on sandpaper for grain size; and Y or N (for yes and no) for those cells describing soil composition

		Soil Composition				
Transect Pt.	Color	Grain Size	Organic?	Sand?	Silt?	Clay?
0 m	Light Brown Yellowish Orange Greenish Gray Olive Gray Light Gray Dark Gray	marbles grains of rice bb's sand paper	Y/N	Y/N	Y/N	Y/N
50 m	Light Brown Yellowish Orange Greenish Gray Olive Gray Light Gray Dark Gray	marbles grains of rice bb's sand paper	Y/N	Y/N	Y/N	Y/N
100 m	Light Brown Yellowish Orange Greenish Gray Olive Gray Light Gray Dark Gray	marbles grains of rice bb's sand paper	Y/N	Y/N	Y/N	Y/N

Orienteer's Map of Site: Part 1, Protocol 2
Draw a map of your forest site. Include your transect, the location of other transects, and permanent features such as roads, streams, and hills. Write down directions so that someone who has never been to your forest could locate the stake at the beginning of your transect.

N

Scale:



Soil Color Card

Pantone 470U	Pantone 139U	Pantone 414U
Light Brown	Yellowish Orange	Greenish Gray
Pantone 417U	Pantone 415U	Pantone 433U
Olive Gray	Light Gray	Dark Gray

Title: Part 2, Protocol 1 -- Measuring the structure of the forest.

Question: Does the forest appear to be regenerating? If so, will the next generation of canopy trees be similar to that of the current one?

Goal: To examine the distribution and ages of the different species of trees in the forest to see if there is an appropriate mixture of seedlings, saplings, subcanopy trees and canopy trees to maintain the forest in its present condition. This will also allow biologists to see if the composition of the forest is typical of an undisturbed site.

Purpose: In Illinois, multi-aged stands of trees provide a diversity of habitats for wildlife and are typical of undisturbed woodlands. In contrast to this, stands of trees which are all the same age allow only particular groups of plants and animals to survive. These stands are prone to outbreaks of insect pests and plant disease, too. In general, an even-aged stand of trees without any younger trees in the subcanopy indicates future problems with the health of the forest.

One common problem of forests in Illinois is that sugar maples are slowly replacing oak and hickory trees. The most likely explanation for this is that people have vigorously prevented forest fires in the state for over a century. Preventing fires allows sugar maples -- which do not survive forest fires well -- to grow and crowd out oak and hickory trees -- which survive forest fires better and often resprout even when the aboveground stems are killed. Forests of oak and hickory are more valued than sugar maple forests because oak and hickory wood is worth more to foresters, acorns and hickory nuts provide more food for wildlife, and oaks and hickories provide better habitat for the native plants of Illinois.

Materials:

110 m rope knotted at 10 m intervals (or 100 m measuring tape)
Compass
Sketch and directions to locate transect
2 Meter Sticks marked at 5, 12.5, 25, 50, and 75 cm
Taxonomist's Guide
Pencil
Clipboard
Data Sheet

Procedure:

1. Read all of the steps in the procedure and assign members in your group the following roles. If you don't have five people in your group, you may take on more than one role. Alternatively, your teacher may wish to assign you to a specific role or two. The roles are:

Facilitator -- makes sure that the group quickly and accurately completes the Protocol by having individuals fulfill their particular tasks.
Recorder -- accurately (and legibly) completes the data sheet.
Orienteer -- uses a compass and map to locate the transect and mark it with a rope (or measuring tape).
Taxonomist -- identifies trees.
Biometrician -- measures the diameter of trees identified by the taxonomist.

2. Gather the materials listed above for your group and follow the directions provided by your teacher for locating the beginning of your transect. Each transect is 15 m from its nearest neighbor, is permanently marked with tent stakes, begins at the edge of the forest, and follows a roughly perpendicular path into the forest. An example is given in Figure 1. These transects were established by students on an earlier visit to these woods. Be sure to use their sketch and directions to help you locate the first stake.

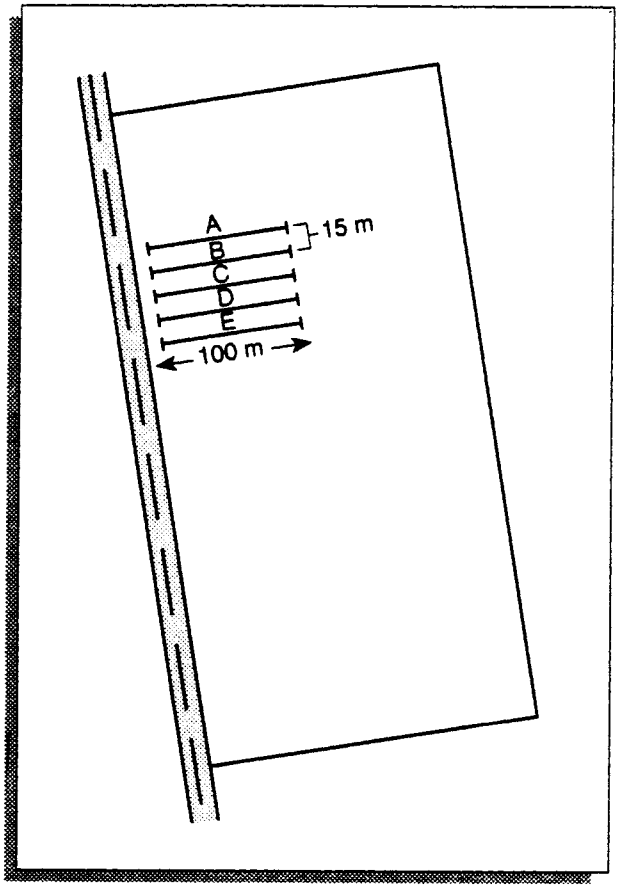


Figure 1. You will work on one of six parallel, 100 m-long transects in the forest.

3. The orienteer is responsible for locating the transect and marking it with a rope (or measuring tape).

Locate the beginning and end of the transect --

> Take the compass and use the bearing provided on the sketch of your transect to determine the general direction of the transect. For example, if your forest site is similar to that in Figure 1, you might take a bearing of 50°. This means that you twist the ring on your compass so that the number 50 is lined up with the arrow on the compass base. You then hold the compass so that the red part of the needle points to N (0°) (Remember...the needle in a compass points North!). Finally, you face the direction the compass base points, pick out a landmark in that direction, and walk straight to it for 100 paces. Somewhere nearby, you should find the stake which marks the end of the transect. Take a look at Figure 2.

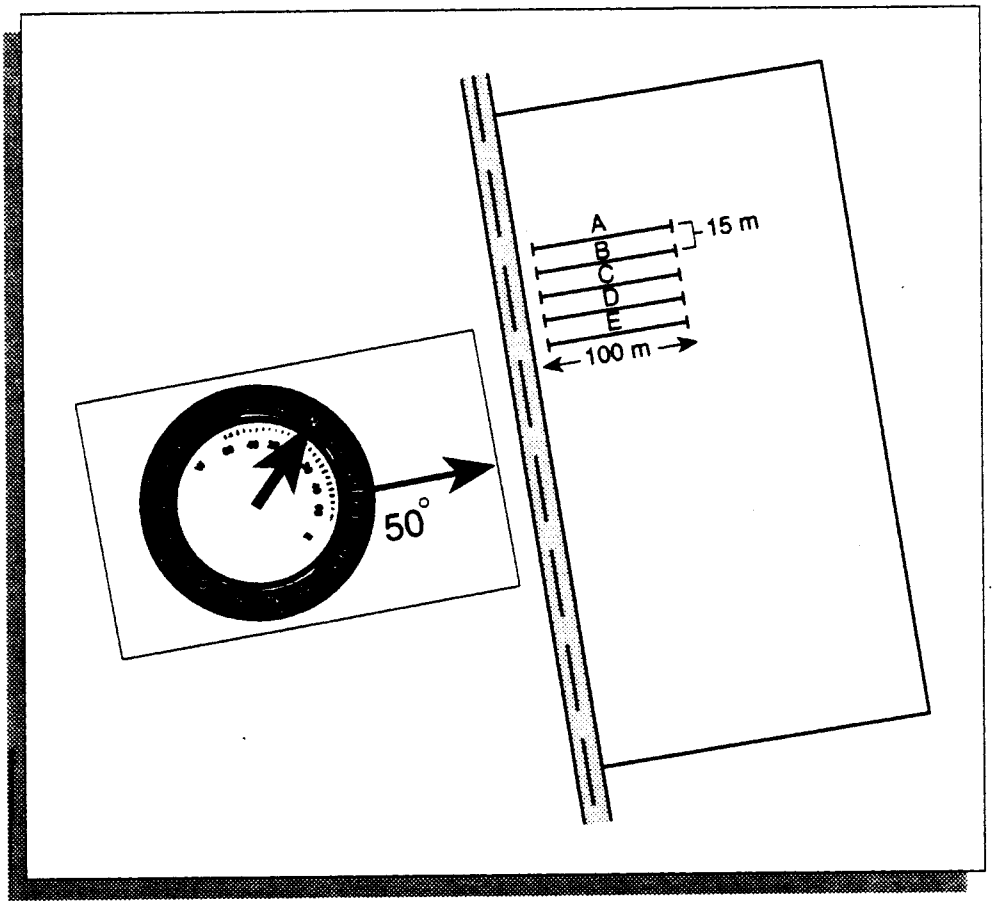


Figure 2. Set your compass to the bearing which your transect follows so that you can locate the stake which marks the end of the transect.

If you are having trouble finding a stake, try locating the landmarks from the map that was drawn by the group which established the transect. From each landmark, have one member of the group point along the direction of the bearing from the landmark to the stake. The stake should be where all three lines meet. Take a look at Figure 3.

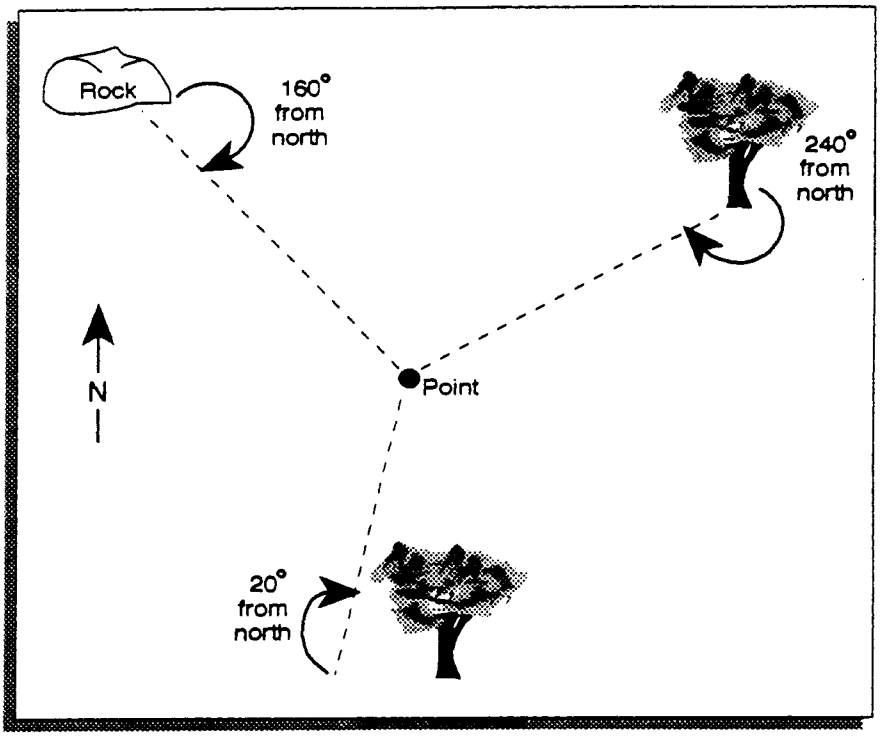


Figure 3. Use triangulation from three landmarks to locate the stake which marks the end of the transect.

If you cannot locate the stake after finding the landmarks place a marker in the place where you think the stake ought to be. Check with the coordinator, then place a new stake in the transect end point and use this new transect end point.

Mark the transect with the rope (or measuring tape) --

Run the 100 m long rope from the tent stake which marks the starting point of the transect to the stake that marks the ending point. Your rope should have knots at 10 m intervals so that you will know how far you are from the beginning of the transect. Alternatively, you may use a 100 m long measuring tape.

4. The taxonomist and biometrician are responsible for identifying, measuring the diameter, and recording the size-class of the trees in each 10 m block along the transect.

Determining if a tree lies inside the transect --

You will only count those trees that lie within 3 m of the line which marks your transect. This means you will be inventorying all of the trees in a 6 m wide path that is 100 m long. See Figure 4.

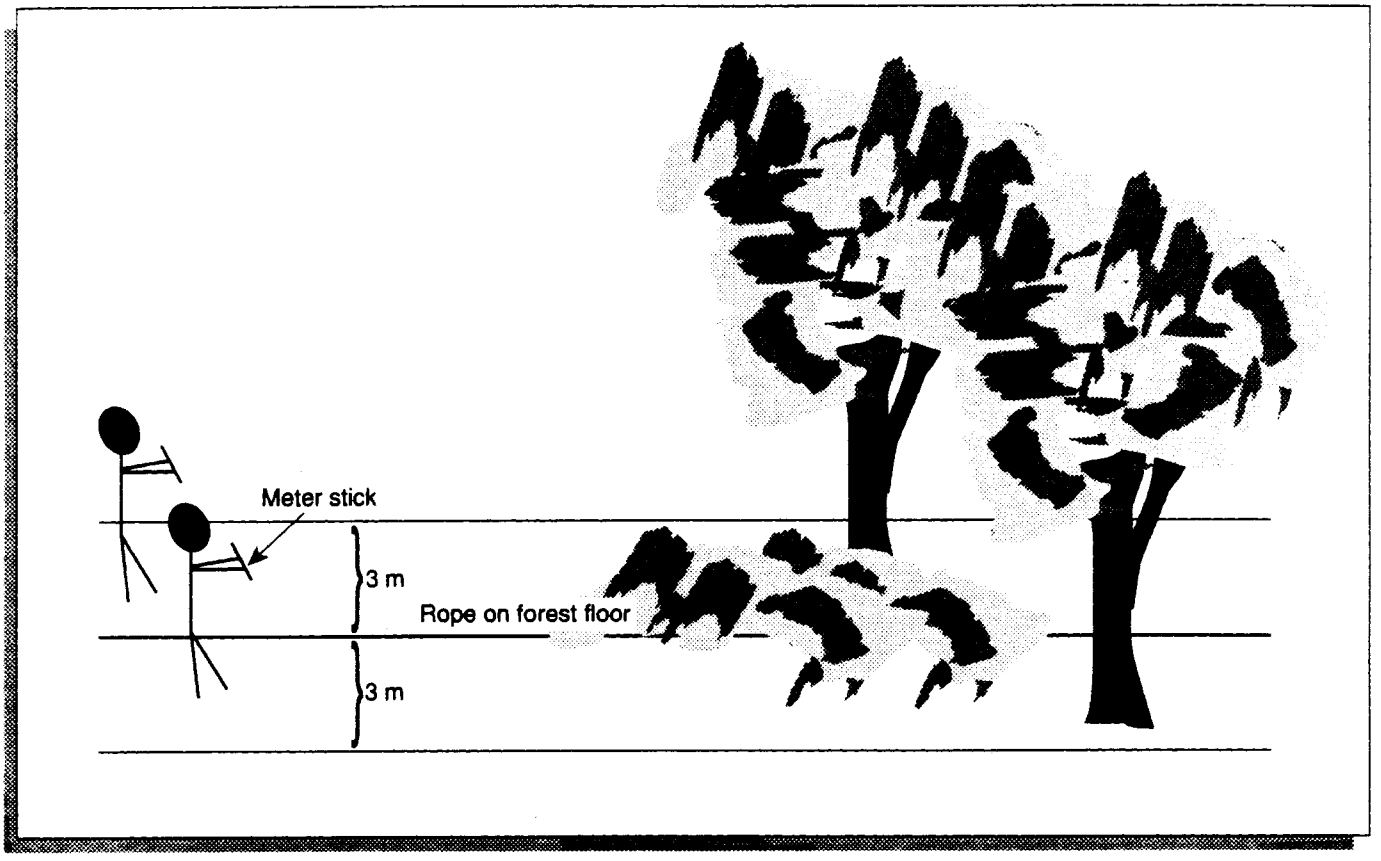


Figure 4. Use the meter sticks to make sure that you count only trees that are within three meters of the transect line.

Trees that are less than half way in (their centers further than 3 m of the transect line) are not to be included in your sample count. Be careful to include only those trees that fall within the transect width guidelines. These data will be used to estimate the density of trees in the forest as well as the composition. Bending the rules (making a wider or narrower transect) will result in erroneous density estimates.

Identifying the genus of the tree --

You will identify the oak, elm, hickory, walnut, maple, ash, beech and pine trees to the level of genus. This means you do not have to distinguish between red maple trees and sugar maple trees -- which are two different species of maples.

To identify the genus to which an individual tree belongs, use the guide provided for the taxonomist. The guide is a dichotomous key which means that it starts with one question and then tells you to go to one of two spots in the key where it asks you another question. At the end of the line of questions, you should find the name of the genus to which the tree you are trying to identify belongs.

Measuring its diameter --

You will measure only those trees that are greater than 5 cm in diameter and taller than 2 m.

You should measure the diameter of the tree 1.3 m above the ground. Measuring the trees at this height standardizes your measurement so that it can be compared to trees measured by other students in other transects and in other forests. If you measure too low, the diameter will be too large. If you measure too high, it will be too small.

Most trees will be easy to measure but some will be odd or irregularly-shaped. For example, a tree that has branch coming out 1.3 m above the ground will have a diameter much larger than if the branch wasn't coming out at that height. Use Figure 5 to guide you on how to adjust for irregularities like these.

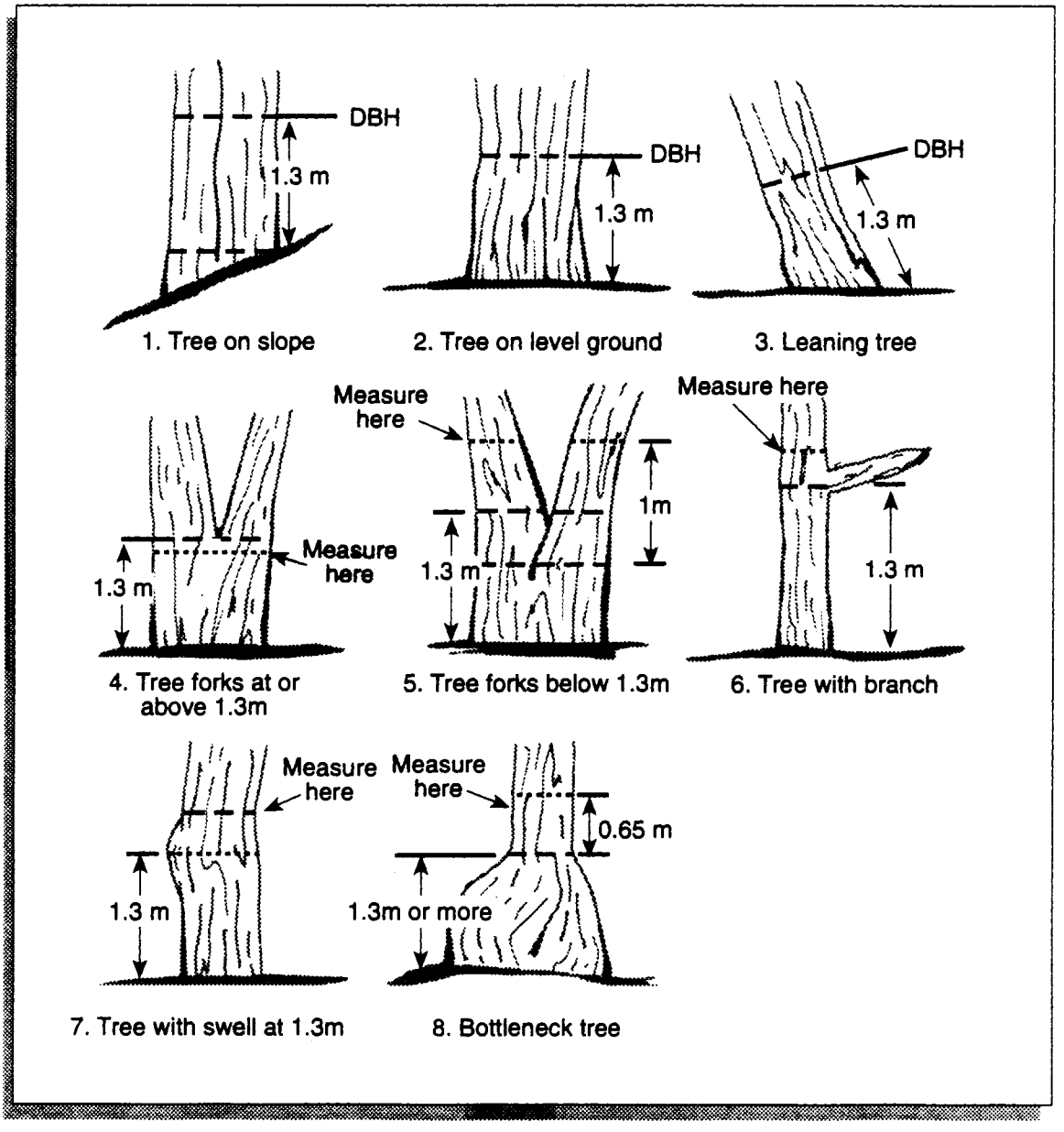


Figure 5. Use this chart to help you decide where you should measure the diameter of the tree.

You will record only whether the trees are 5 - 12.5, 12.5 - 25, 25 - 50 , 50 - 75 or greater than 75 cm in diameter. Consequently, you don't need to find out if a tree is 62 cm or 63 cm across. You only need to find out if it is between 50 and 75 cm in diameter.

You can easily tell if a tree falls into any of these classes by using a meter stick which has tape marks at 5, 12.5, 25, 50, and 75 cm. Make sure that you are accurately reading the meter stick and avoiding problems with parallax. Parallax refers to the problem of making an accurate reading if you are trying to measure something at an angle. In this case, make sure that you line up the end of the meter stick with the edge of the tree for your first sighting, then shift your head so that your line of sight on the far side of the tree is parallel to the first. This way, your measurement of the diameter of the tree will be more accurate. Check out Figure 6.

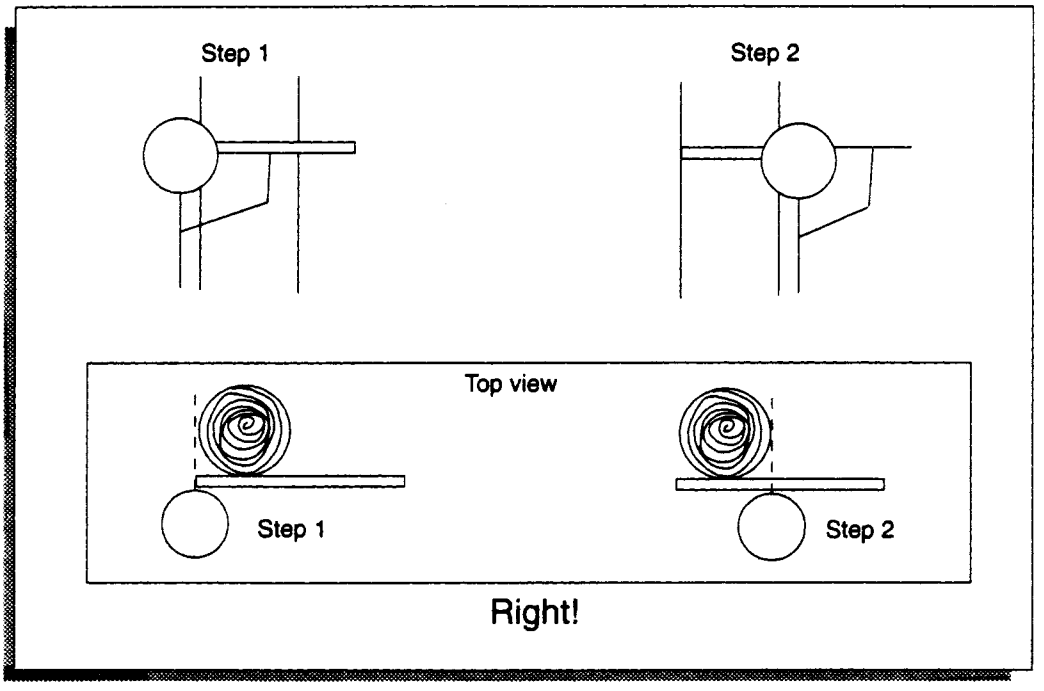


Figure 6. Avoid problems with parallax by making sure that the two lines of sighting are parallel.

Recording your data --

For an example of how to complete your data sheet, look below.

Transect Interval	Genus	Size Class				
		5 - 12.5	12.5 - 25	25 - 50	50 - 75	> 75 cm
1 - 10	elm	X				
20 - 30	oak				X	

Summary --

In short, for every tree taller than 2 m, with a diameter greater than 5 cm, lying within 3 m of either side of your transect, you need to:

- Identify it to genus.
- Measure its diameter at a height of 1.3m.
- Record where it falls on the transect, its genus, its size class.

Have fun!

6. Turn in your tools and data sheet to your teacher. Congratulations, you are done with this protocol! Plan on preparing your data for submission to the Illinois ForestWatch coordinator.

Task Checklist: Part 2, Protocol 1

Use this checklist to make sure that you have completed all of the tasks in the protocol.

Everyone should...

- ❑ Read all of the steps in the procedure and take on the various roles.
- ❑ Gather the materials needed to complete the protocol.

The Facilitator should...

- ❑ Help everyone to complete their tasks and keep them focused on the tasks.

The Recorder should...

- ❑ Make sure that all of the data is gathered and legibly recorded.

The Orienteer should...

- ❑ Locate the beginning and end of the transect.
- ❑ Mark the transect with the rope (or measuring tape).

The Taxonomist and Biometrician should...

- ❑ Determine if a tree lies inside the transect.
- ❑ Identify the genus of the tree.
- ❑ Measure its diameter.
- ❑ Record the data.
- ❑ Repeat this for every tree within the transect.

After completing the protocol, everyone should...

- ❑ Prepare the data for submission to the ForestWatch Coordinator

Part 2, Protocol 1: Data Sheet

Date	

Name	Role
1.	
2.	
3.	
4.	
5.	

Site Location	
County:	
Township Name:	
Township (ex. T12S):	
Range (ex. R4W):	
Section Number:	
Transect Letter	
Compass Bearing	

Tree Size Data Sheet
Record the transect interval, genus, and tally the size class for each tree taller than 2 m and larger than 5 cm in diameter along your transect

Please use only the following choices as possible answers --

Transect Interval: 1-10 m, 10 - 20 m, 20 - 30 m, 30 - 40 m, 40 - 50 m, 50 - 60 m, 60 - 70 m, 70 - 80 m, 80 - 90 m, 90 - 100 m.

Genus: Oak, Elm, Maple, Hickory, Beech, Ash, Pine, Other

Transect Interval	Genus	Size Class				
		5 - 12.5	12.5 - 25	25 - 50	50 - 75	> 75 cm
1 - 10	elm	X				
20 - 30	oak				X	

Taxonomist's Key: Part 2, Protocol 1

To use this key, select a typical twig and leaves of the tree you wish to identify. Begin at No. 1 and proceed step by step. Each step will give you one of two choices. When you have made your final choice, compare your twig and leaves to the page that illustrates that genus!

Some words that you will need to know include:

Leaf -- has a bud at its base. Believe it or not, sometimes when you are looking at a "leaf" you may be looking at only a small portion of the leaf. You can tell if you have an entire leaf by looking at where the "leaf" joins the "twig". If there is a little bud where the two meet, then you have a true leaf. If not, then you are looking at one leaflet of a leaf that is made up of many leaflets. Look farther down the twig until you find a bud. Take a look at Figure 7.

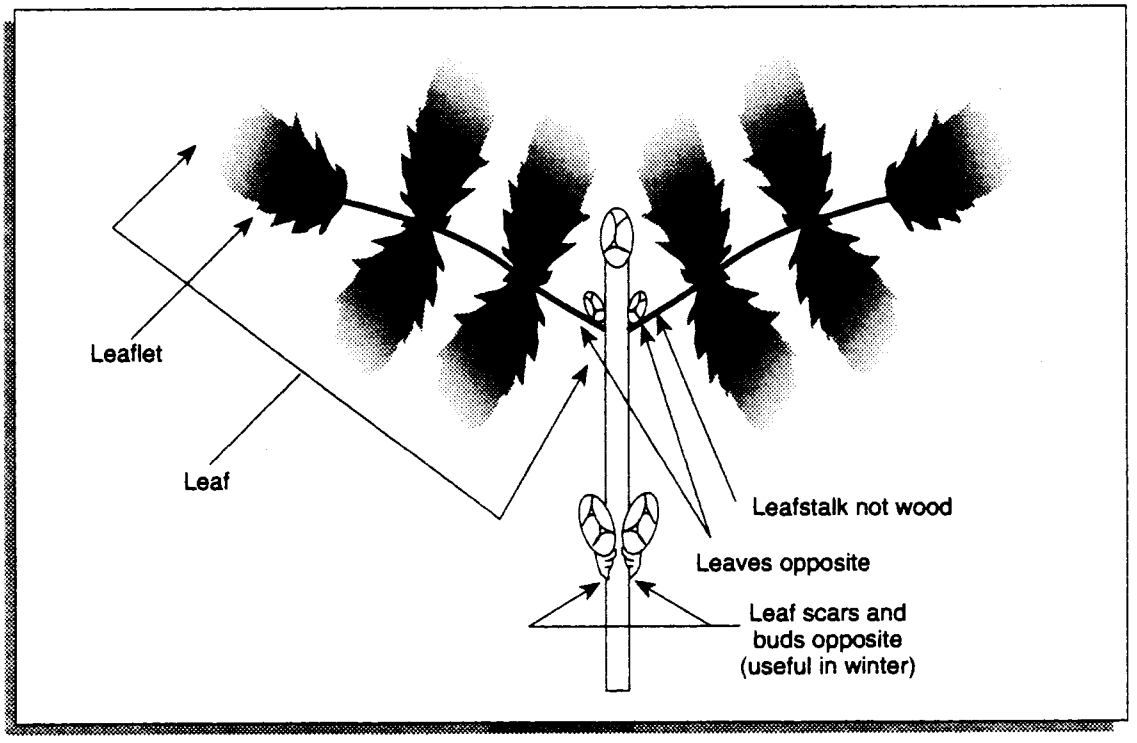


Figure 7. A leaf has a bud at its base where it joins the twig. It may have a single blade or it may be made up of many leaflets.

Compound leaves -- are made up of many leaflets. Leaflets do not have a bud at their base.
Simple leaves -- have only one big blade and have a bud at their vase. See Figure 7.

Opposite leaves -- are paired on opposite sides of the twig.
Alternate leaves -- do not grow opposite each other. See Figure 8.

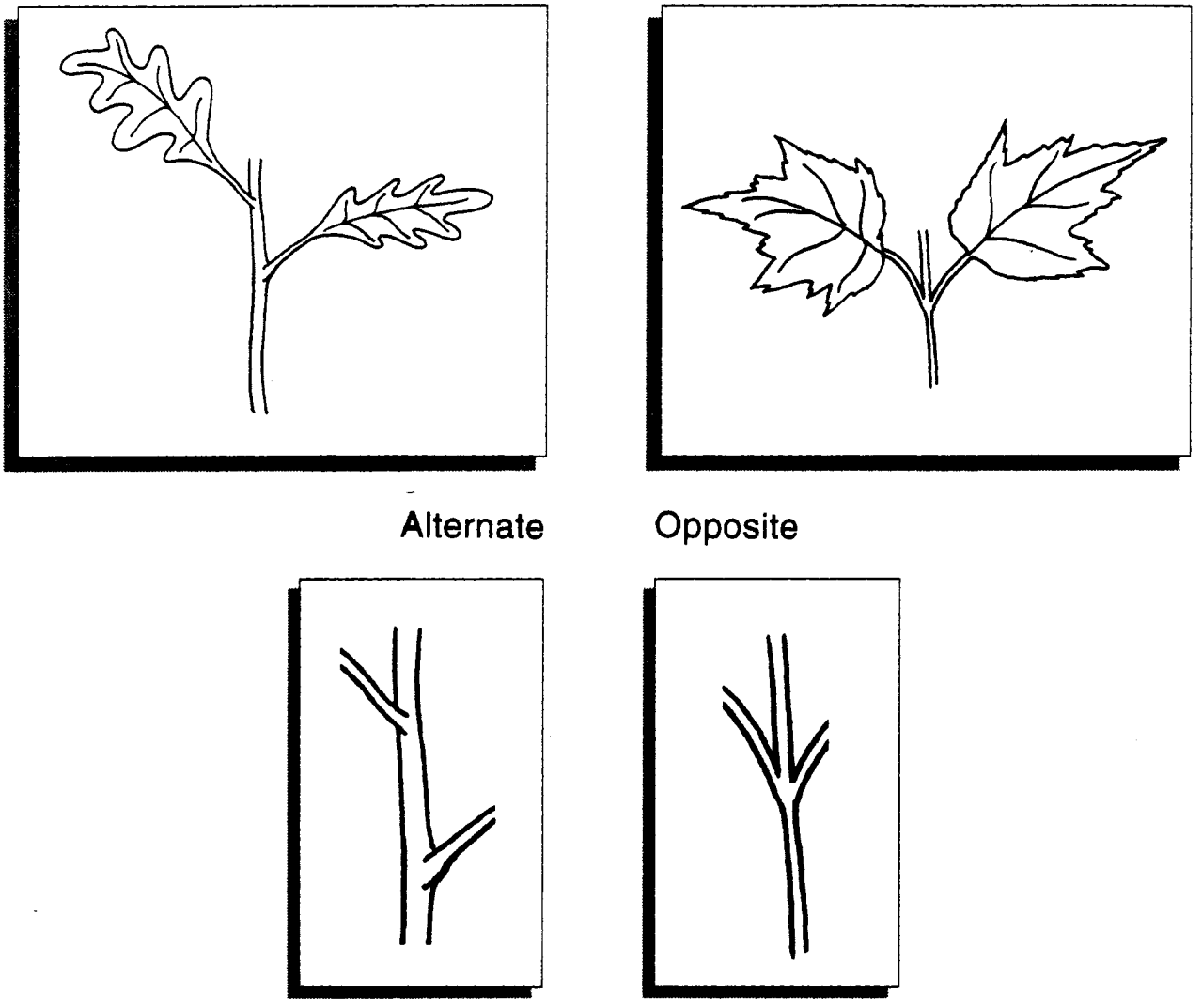


Figure 8. Opposite leaves grow in pairs opposite one another on the twig. Alternate leaves grow singly on alternate sides of the twig.

Lobed leaves -- the leaf has lobes (where the blade sticks out) and sinuses (where the blade is missing). Both leaves in Figure 8 are lobed.
Entire leaves -- the leaf has a smooth edge without sinuses (ins) and lobes (outs).

Symmetrical leaf -- the right and left sides are mirror images of one another.
Asymmetrical leaf -- the right and left sides do not mirror one another.

Taxonomist's Dichotomous Key to Some Common Illinois Trees

1. Is the tree evergreen? Does it have needle-like or scale-like leaves which do not fall off in winter? If yes, go to 2.

    2. Are the leaves needle-shaped? Are they in clusters of 2 - 5 ? If yes, then check your cards to see if it is a PINE tree.

2. Are the leaves scale-like or single needles? Then it is not a pine. Classify it as OTHER.

1. Does the tree have broad leaves that fall off in the winter? If yes, go to 3.

3. Are the leaves compound? (A leaf may have one main piece or many.) You can tell what consists of a whole leaf by looking for a bud where the leaf joins the twig. If it has many leaflets, then the leaf is compound.) If yes, go to 4.

4. Are the leaves opposite from one another on the twig? If yes, go to 5.

5. Check your cards to see if it is an ASH.
5. If not, classify it as OTHER.

4. Are the leaves alternate from one another on the twig? If yes, go to 6.

6. Does it have 5 - 9 leaflets? (Those things that look like little leaves but are not true leaves because they do not have a bud at their base). If yes, go to 7.

7. Check your cards to see if it is a HICKORY.
7. If not, classify it as OTHER.

6. Does it have 11 - 23 leaflets? If yes, go to 8.

8. Check your cards to see if it is a WALNUT.
8. If not, classify it as OTHER.

3. Are the leaves simple? Is there a bud where the stem of the 'leaf' meets the twig? If yes, go to 9.

9. Are the leaves opposite from one another on the twig? If yes, go to 10.

10. Check your cards to see if it is a MAPLE.
10. If not, classify it as OTHER.

9. Are the leaves alternate from one another on the twig? If yes, go to 11.

11. Do the leaves have lobes? If yes, go to 12.

12. Check your cards to see if it is an OAK.
12. If not, classify it as OTHER.

11. Are the leaves essentially entire? If yes, go to 13.

13. Is the base of the leaf blade asymmetrical where it meets the petiole? If yes, go to 14.

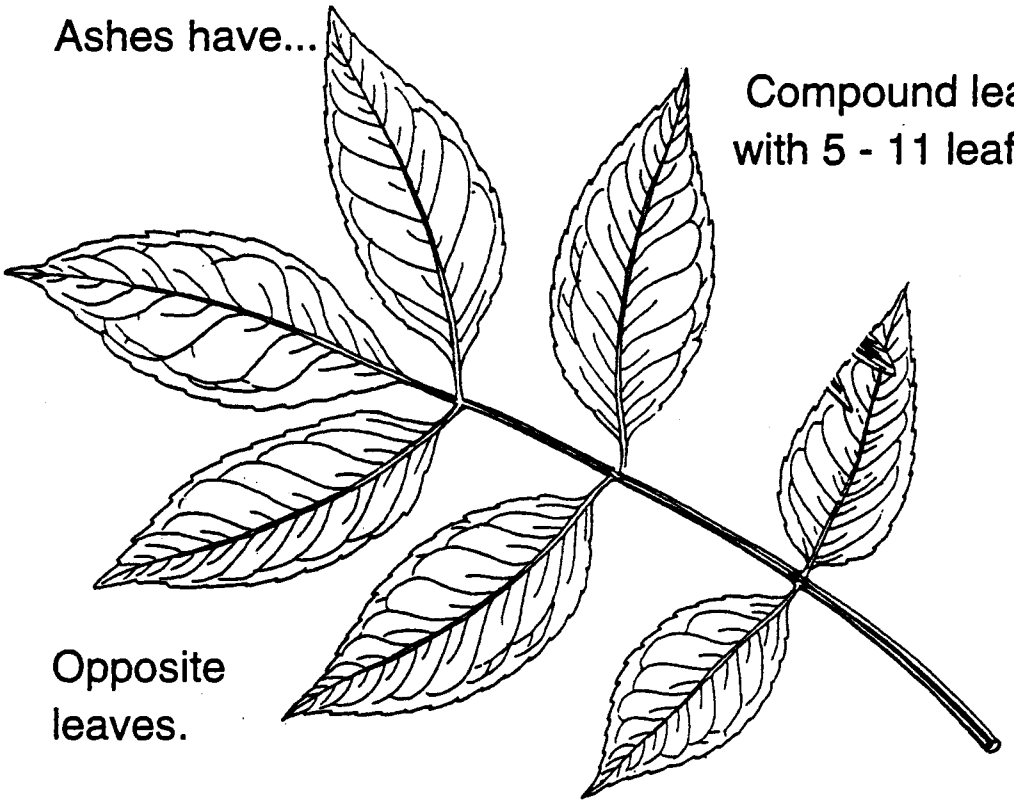
14. Check your cards to see if it is an ELM.
14. If not, classify it as OTHER.

13. Is the base of the leaf blade symmetrical where it meets the petiole? If yes, go to 15.

15. Check your cards to see if it is a BEECH.
15. If not, classify it as OTHER.

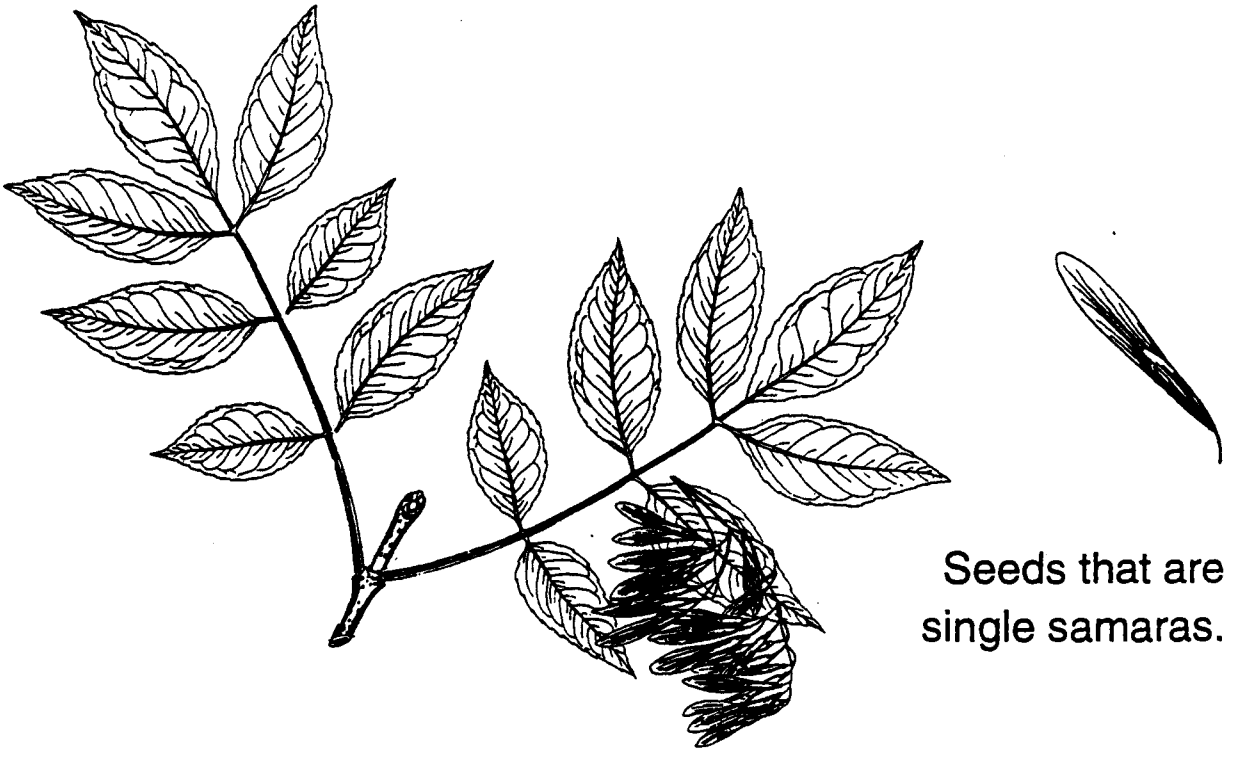
Ash Reference Card

Ashes have...



Compound leaves with 5 - 11 leaflets.

Opposite leaves.

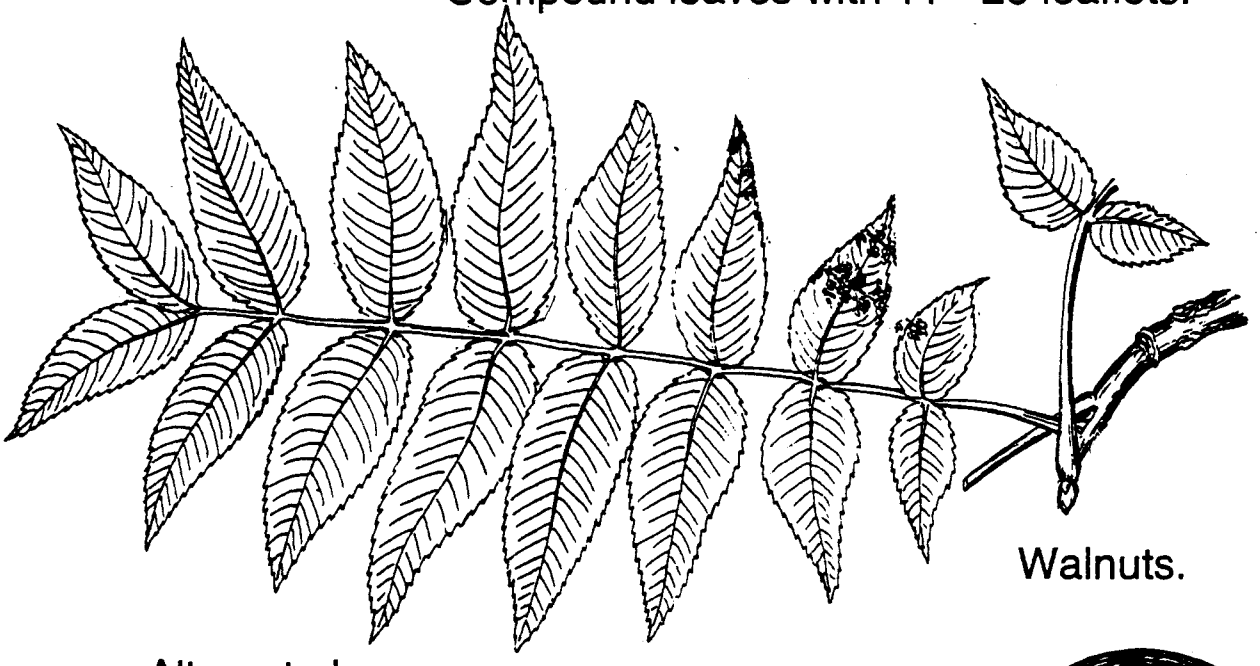


Seeds that are single samaras.

Walnut Reference Card

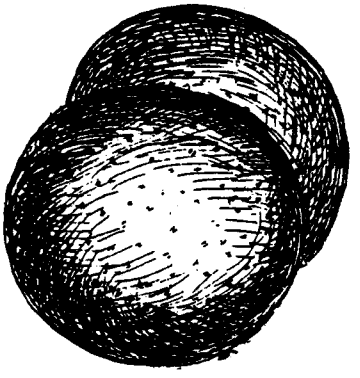
Walnuts have...

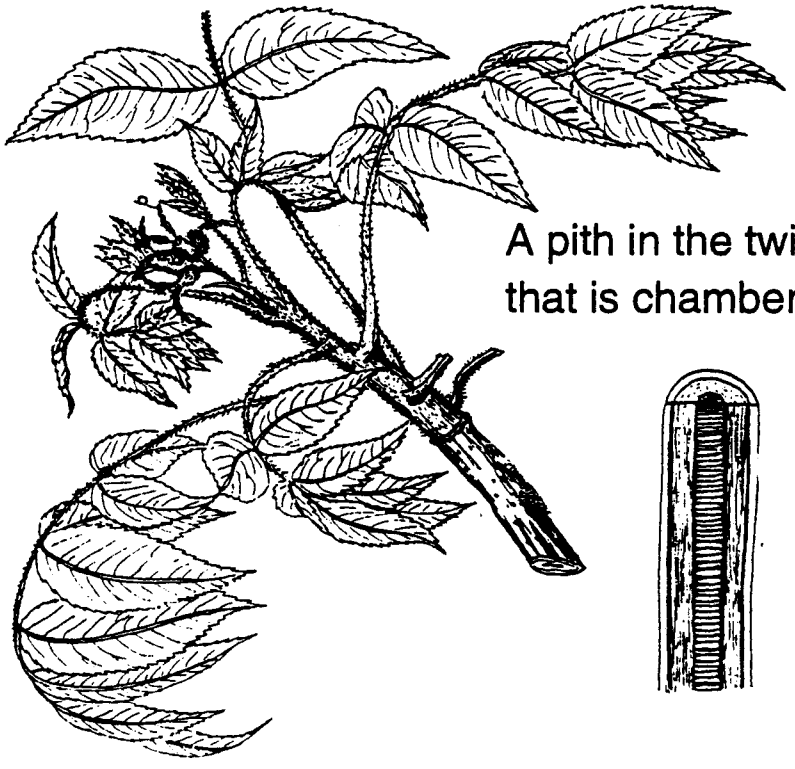
Compound leaves with 11 - 23 leaflets.



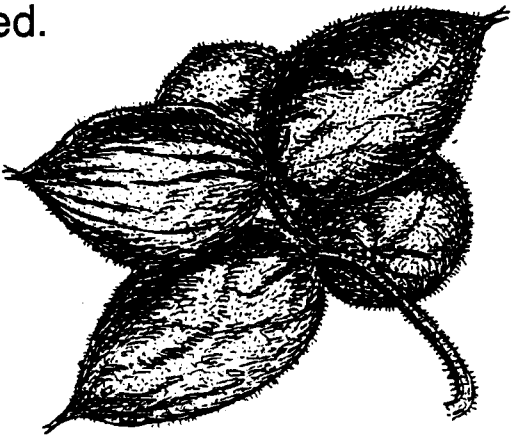
Walnuts.

Alternate leaves.



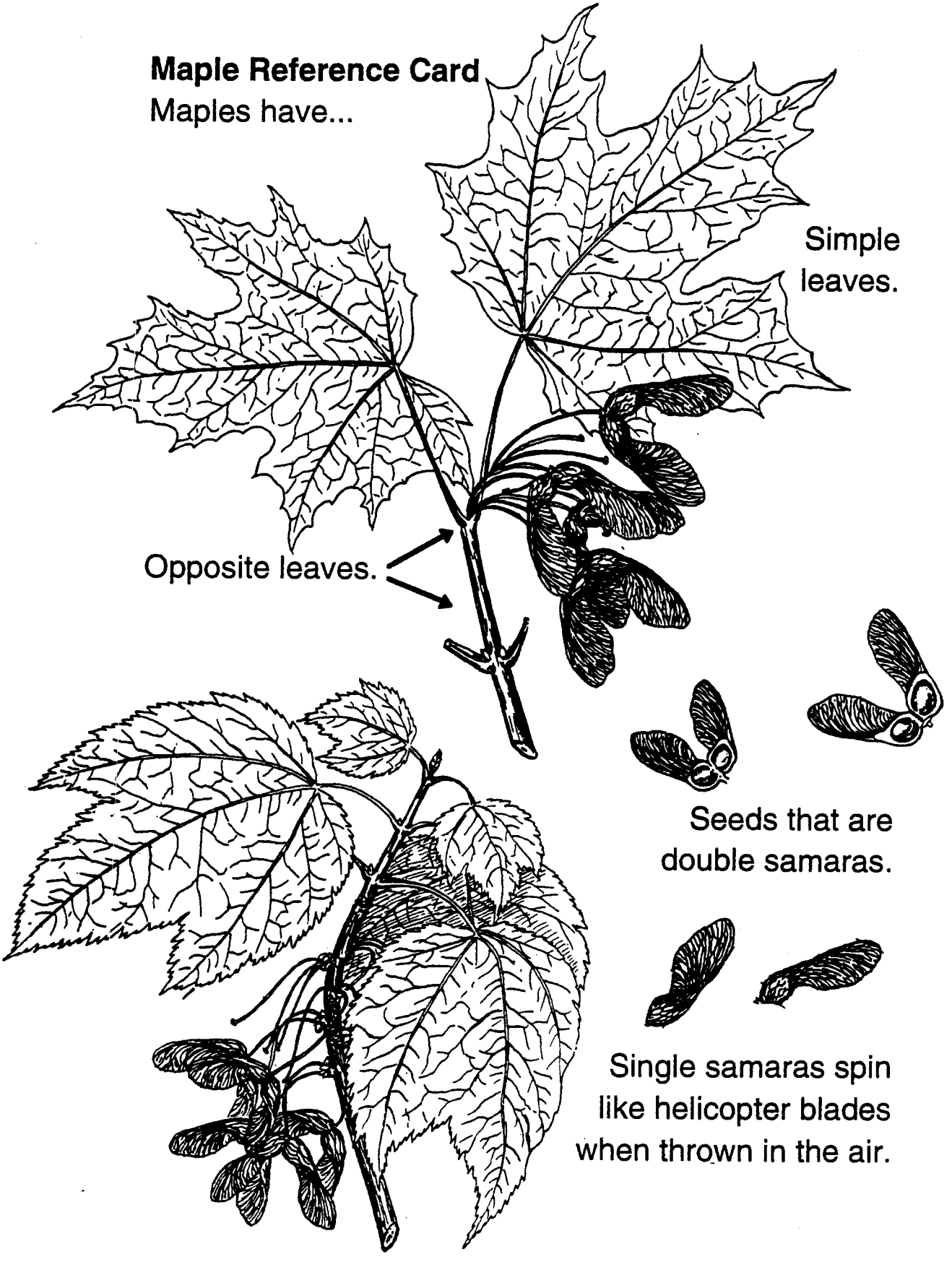


A pith in the twig
that is chambered.



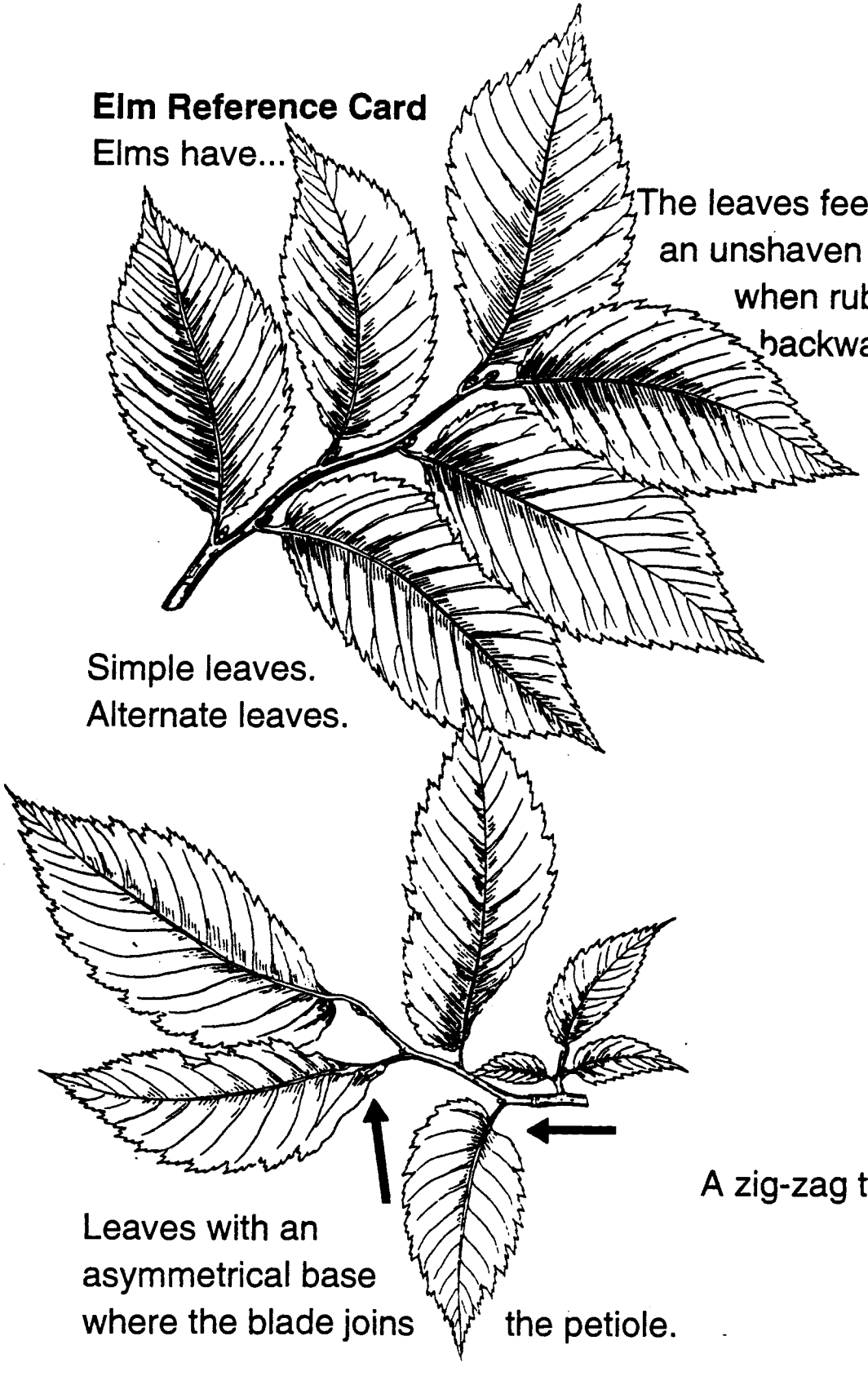
Maple Reference Card

Maples have...



Elm Reference Card

Elms have...



The leaves feel like an unshaven face when rubbed backwards.

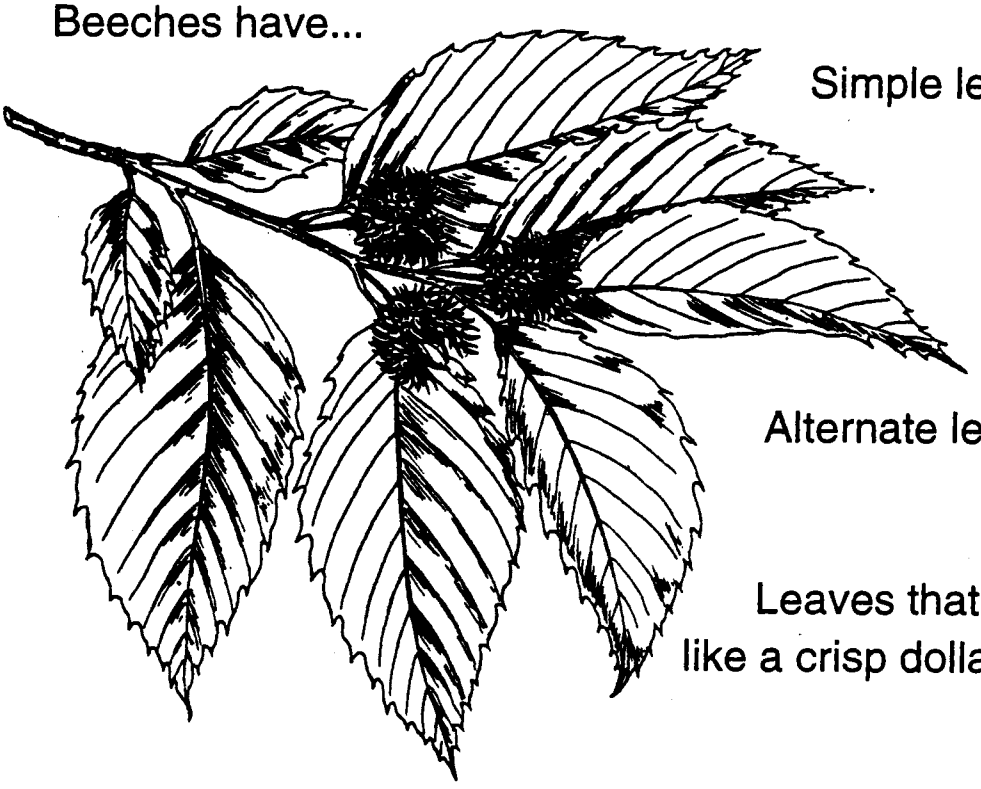
Simple leaves.
Alternate leaves.

A zig-zag twig.

Leaves with an asymmetrical base where the blade joins the petiole.

Beech Reference Card

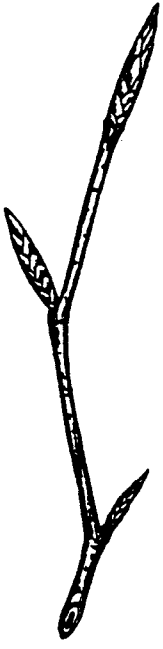
Beeches have...



Simple leaves.

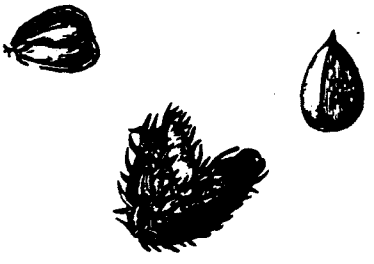
Alternate leaves.

Leaves that snap like a crisp dollar-bill.



Buds that are long and pointed.

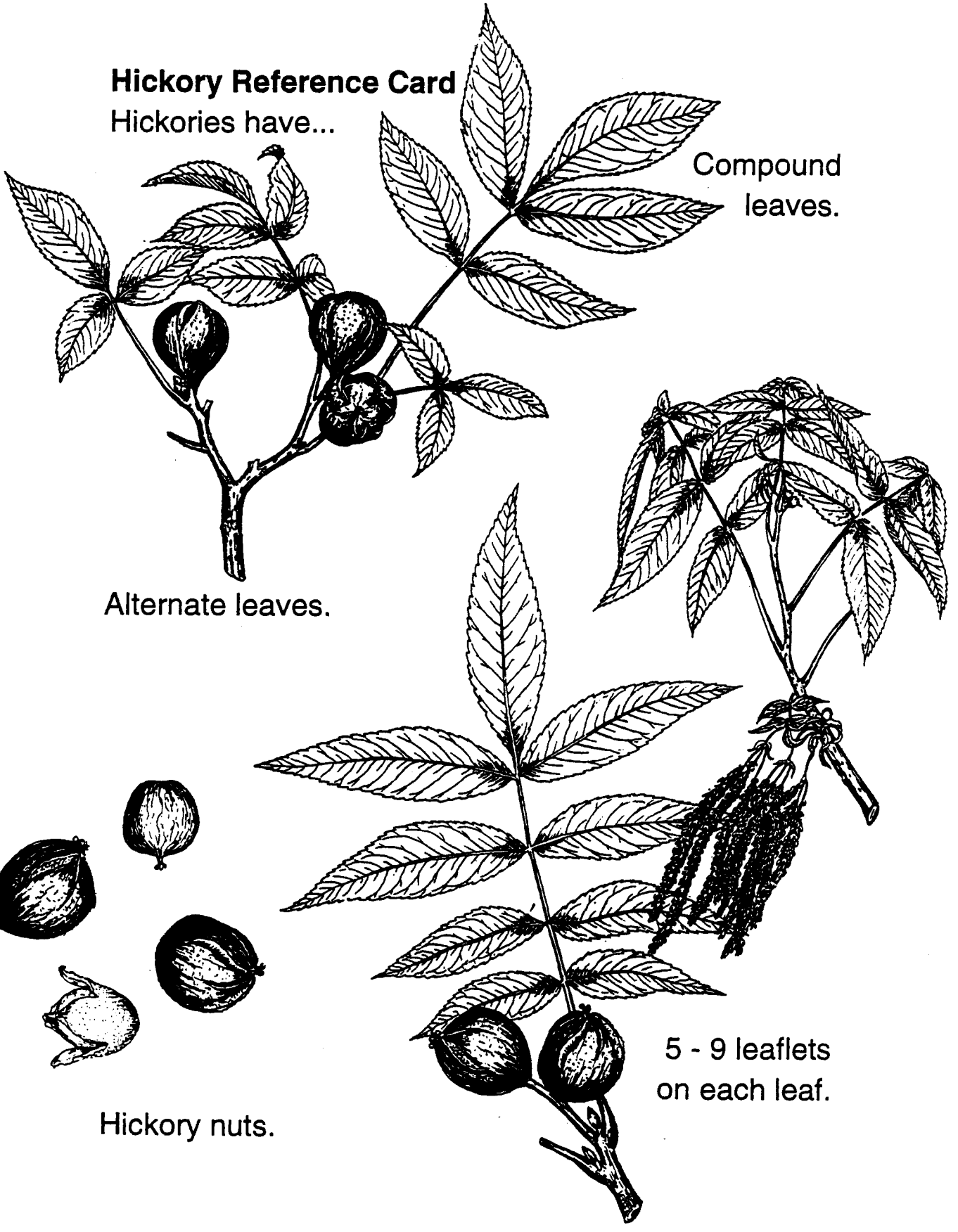
Beech nuts which have bristly husks enclosing two to three triangular seeds.



Smooth, ashy-gray bark.

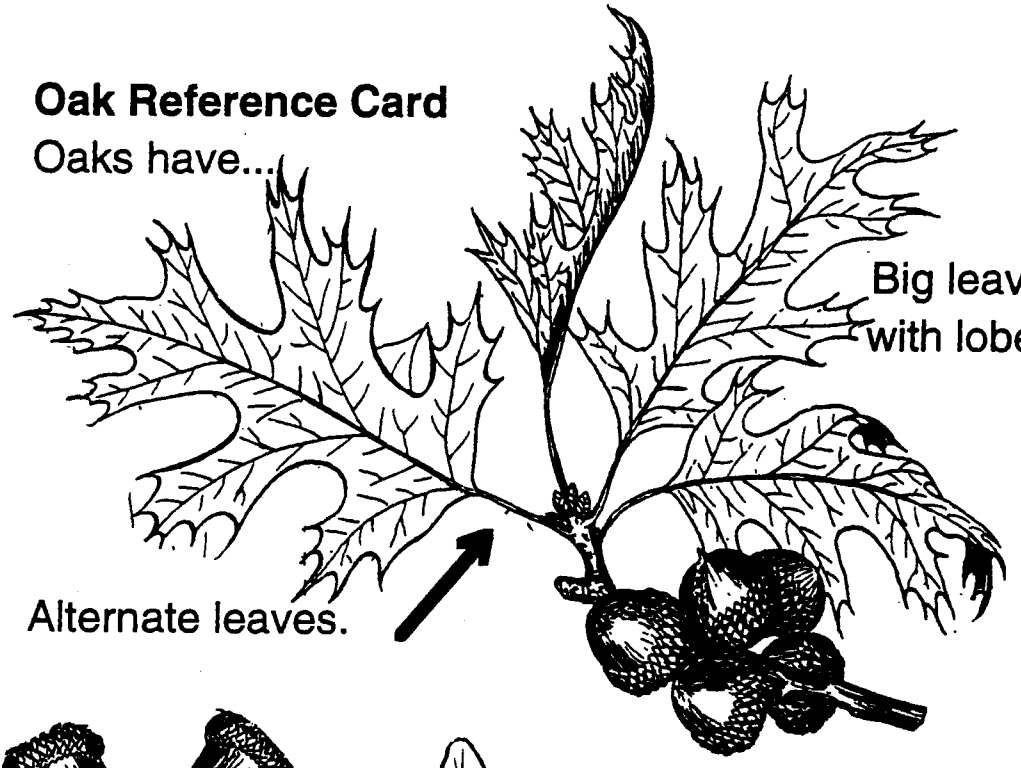
Hickory Reference Card

Hickories have...



Oak Reference Card

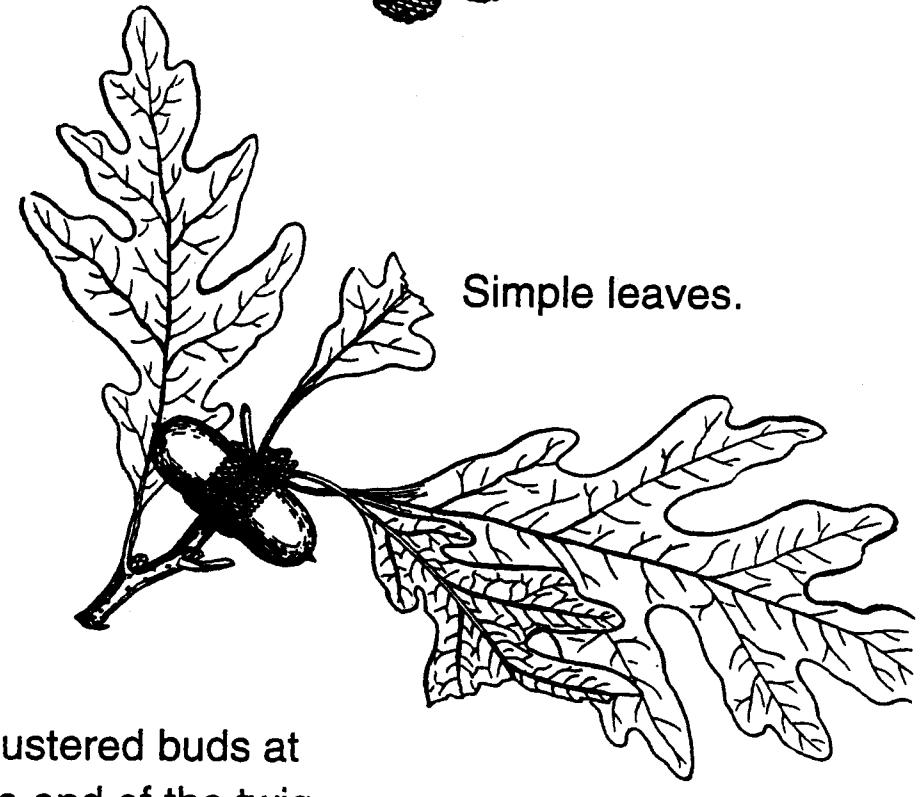
Oaks have...



Big leaves with lobes.

Alternate leaves.

Acorns.



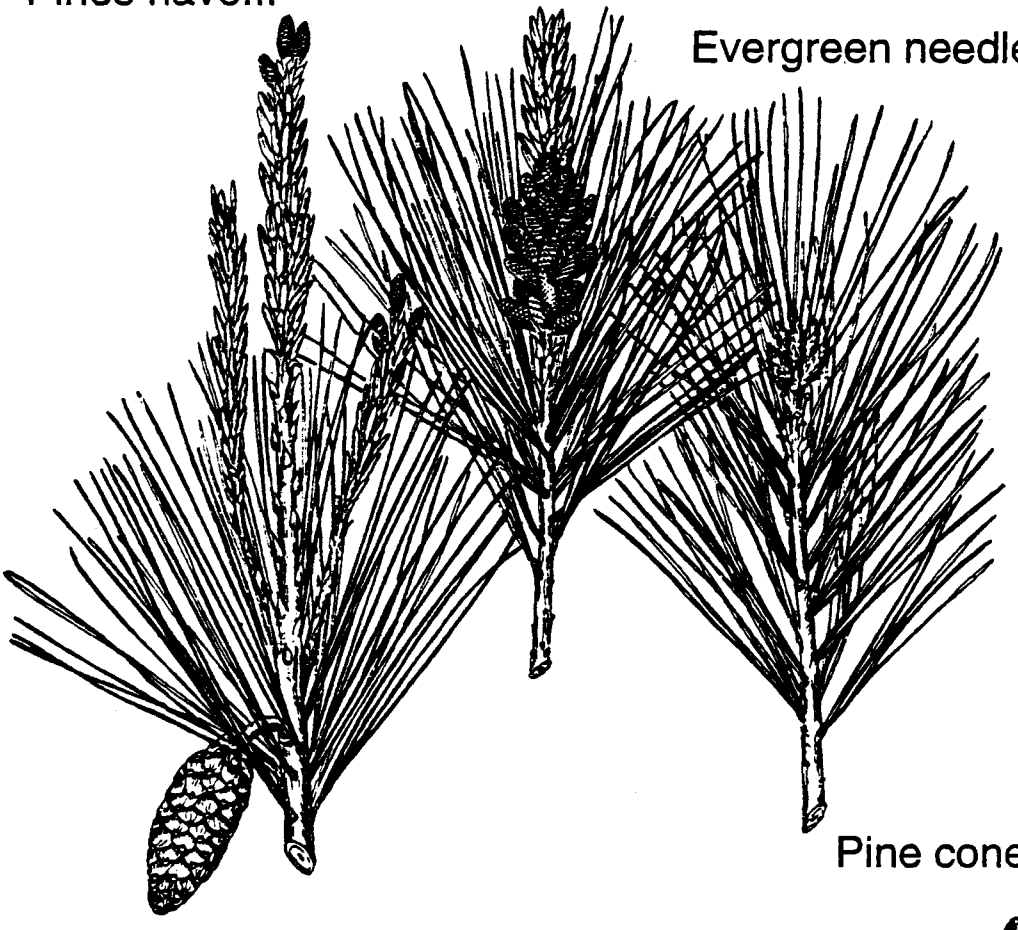
Simple leaves.

Clustered buds at the end of the twig.

Pine Reference Card

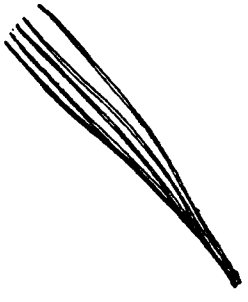
Pines have...

Evergreen needles.



Pine cones.

Needles in bundles of 2 to 5.



Title: Part 2, Protocol 2a -- Surveying invasive non-native species of plants.

Question: Are certain non-native plant species invading Illinois' forests?

Goal: To detect changes in the abundance of non-native species of plants and to assess whether they are reducing biodiversity by replacing native species in the forest.

Purpose: One of the goals of forest managers in Illinois is to maintain biological diversity. Biological diversity refers to the variety of life that occurs at all levels of biological organization. Sometimes it refers to the diversity of genes in a population. For example, if you consider your class to be a population, you can count part of its genetic diversity by tallying the different eye colors of the people in your class (assuming that your classmates don't wear colored contacts). Sometimes biological diversity refers to the variety of species in an area. For example, you may try to count the number of species of organisms in your classroom from the silverfish that hide in the drain of the sink to the plants on the counter. Sometimes it refers to the variety of ecosystems in an area. For example, you may try to count the different areas around your school such as a nearby patch of woods, a stream, and a field.

One area of biodiversity that is of particular concern is the abundance of invasive non-native species. Non-native species are species that did not originally grow in Illinois and probably dispersed here after the first Europeans settled the area. For example, starlings are a non-native bird species that was intentionally brought to the United States from England. The number of non-native plant species has consistently increased through the 20th century. At present, over 25 percent of the plant species in Illinois are not native to the state. Garlic mustard, a plant that is originally from Eurasia, now grows in many of Illinois forests where it crowds out other species that are native to the area.

Biologists in Illinois are interested in knowing about the non-native plants you will be censusing in this protocol because they know that these plants are particularly aggressive and often crowd out a wider variety of native plants that would grow in the area if the non-natives were not here.

Materials:

110 m long rope knotted at 10 m intervals (or, recommended, a 100 m measuring tape)
4 Sturdy Pieces of String, 7.5 m long with a large loop on one end
2 (or 4, if available) Meter Sticks
Species Reference Cards
Data Sheet
Clipboard
Pencil

Procedure:

1. Read all of the steps in the procedure and assign members in your group the following roles. If you don't have five people in your group, you may take on more than one role. Alternatively, your teacher may wish to assign you to a specific role or two. The roles are:

Facilitator -- makes sure that the group quickly and accurately completes the protocol by having individuals fulfill their particular tasks.

Recorder -- accurately (and legibly) completes the data sheet.
Botanist for Garlic Mustard and Rocket -- identifies and inventories the occurrence of Garlic Mustard and Rocket along the transect.
Botanist for European High-bush Cranberry and Multiflora Rose -- identifies and inventories the occurrence of European High-bush Cranberry and Multiflora Rose along the transect.
Botanist for Buckthorn and Honeysuckle -- identifies and inventories the occurrence of Buckthorn and Honeysuckle along the transect.

2. Gather the materials listed above for your group. Locate your transect and run a rope that is knotted every 10 m between the stakes that mark its beginning and end. (You may have already done this, if not check the instructions for doing this in Part 2, Protocol 1.) Alternatively, you may do this with a 100 m measuring tape.

3. The Botanists are responsible for documenting the presence or absence of their particular species in each 10 m segment of the transect. If the species occurs in that segment they then must estimate the density of that species.

Documenting the presence or absence of a species --

Use the Species Reference Cards to learn about each plant. Make sure you notice all of the small details that will let you identify and locate your particular species and distinguish it from other similar species.

Your task is to scan each 10 m segment of the transect for the presence or absence of your target species. In other words, if you are the botanist for Garlic Mustard and Rocket, you will look for those two species.

Start in the first segment, the one that runs from 0 to 10 m. Look for your species and record if it is present or absent.

To make sure that you are looking only in the area 7.5 m from the line, take the 7.5 m long pieces of string and slip their loops over the transect line. Position the strings so that two are at the 0 m mark and two are at the 10 m mark. Arrange them so that they are perpendicular to the transect. Be sure to stay within the boundaries of these strings when you search for your species. Check out Figure 1.

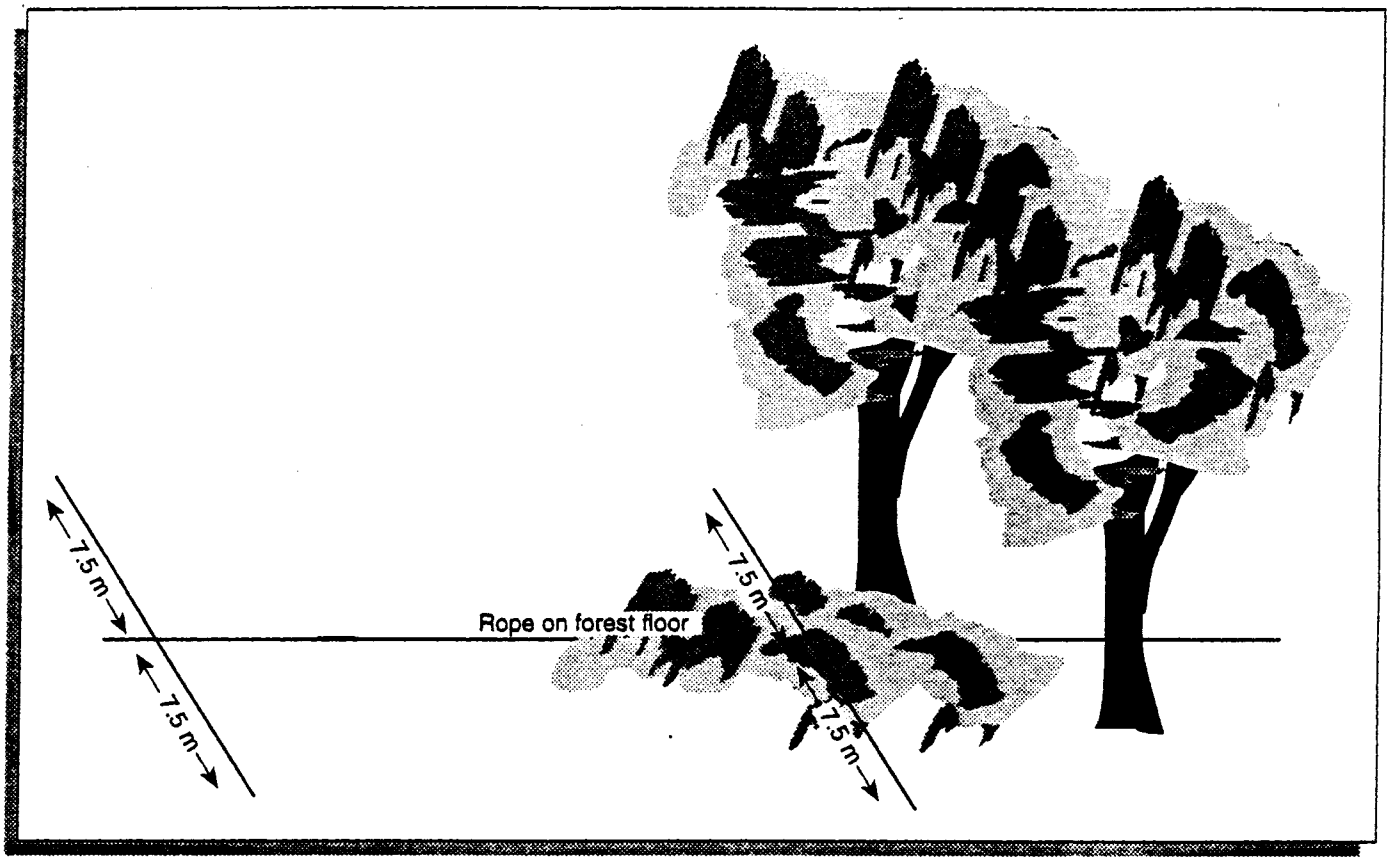


Figure 1. Use the 7.5 m strings to define the boundaries of the 10 m x 15 m plot.

HINT: When you are counting plants, count only those that are rooted in the area where you are looking. Also, if you see several stems coming out of one point in the soil, count all of those stems as a single plant.

Repeat this procedure for every 10 m segment until you reach the end of the transect.

Now you will back-track along the transect. For each of the 10 m segments which contained your particular species, you need to estimate the density of the species. Density refers to the number of individuals in a certain area.

Determining the density of Garlic Mustard, or Rocket if they are present --

You will first estimate the density by counting the number of individuals in that portion of the transect which is within 1 m of the transect line. Take a meter stick and hold it perpendicular to the transect line. Walk the 10 m segment and count every individual of your species that is rooted within a meter of the transect line. Take a look at Figure 2 for a better idea of how it is done.

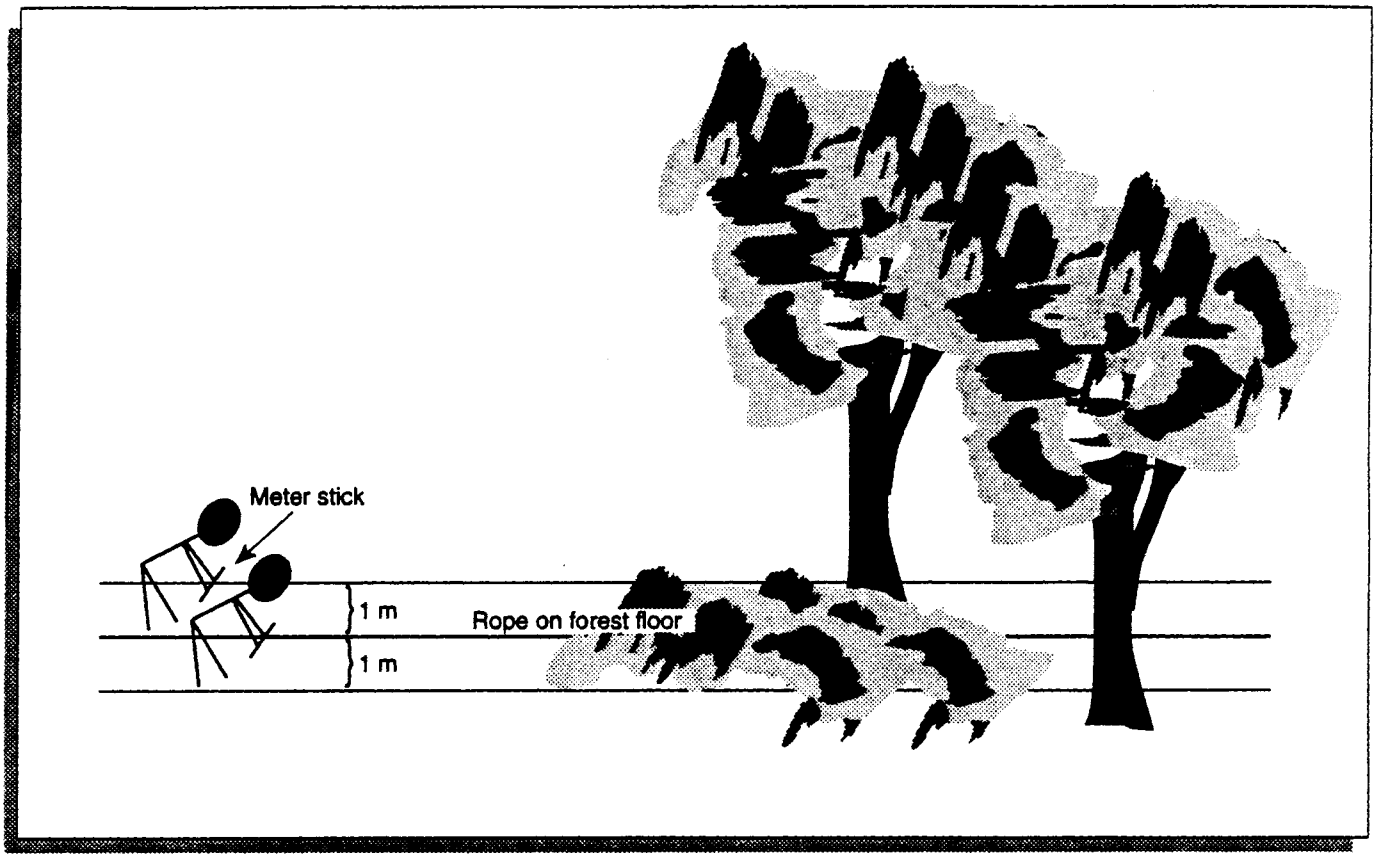


Figure 2. Walk with a meter stick perpendicular to the transect line and count the number of plants which pass underneath it.

In some cases, you may have found the plant in the 10 x 15 m segment of the transect, but not within the 10 x 2 m segment centered on the transect line. That is OK, simply note that 0 plants are growing within a meter of the transect line.

In contrast to this, you may find some plants that are extremely abundant. In fact, there may be so many that they will be difficult to count. Consequently, if there are more than 100 individuals (in some cases there may be thousands!), you have to use a different technique.

For species that have more than 100 individuals in the 10 m long by 2 m wide strip centered on the transect line, you will estimate the density by measuring the area occupied by 100 individual plants.

To accomplish this task begin at the start of your 10 m segment. Using your meter stick, slowly move forward with your meter stick perpendicular to the transect with one end on the transect line. Count all of the plants that cross under the meter stick. When you reach 100, stop and record the length of the transect line over which you counted plants (This will be extremely easy if you used a measuring tape instead of a rope when you laid out your transect). For example, if you started at the 10 m mark and counted 100 plants by the time you got to 14.2 m, then you sampled 4.2 m^2. Check out Figure 3.

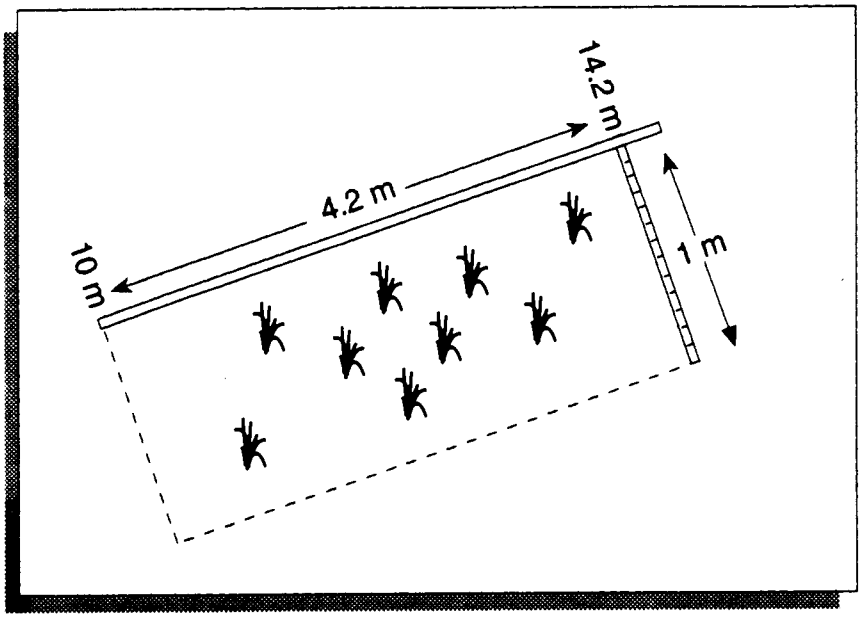


Figure 3. For dense stands of non-native plants, determine the area occupied by 100 individuals using this method. The area will be the distance you move along the measuring tape (the length) multiplied by 1 m (the width).

Record your estimates of the numbers of individuals of each species, as a number if there are less than 100 in a 2 m x 10 m patch, or as the area needed to contain 100 individuals if there are more.

Determining the density of Multiflora Rose, European High-bush Cranberry, the Buckthorns, or the Honeysuckles, if they are present --

Multiflora Rose, European High-bush Cranberry, the Buckthorns, and the Honeysuckles are all shrubs and, consequently, it may be difficult to distinguish where one individual starts and another leaves off. For these plants, you will simply count the number of distinct clumps that occur within 7.5 m of the rope in this 10 m segment of the transect. This means that you will count all of the clumps in a 10 m by 15 m area. See Figure 4.

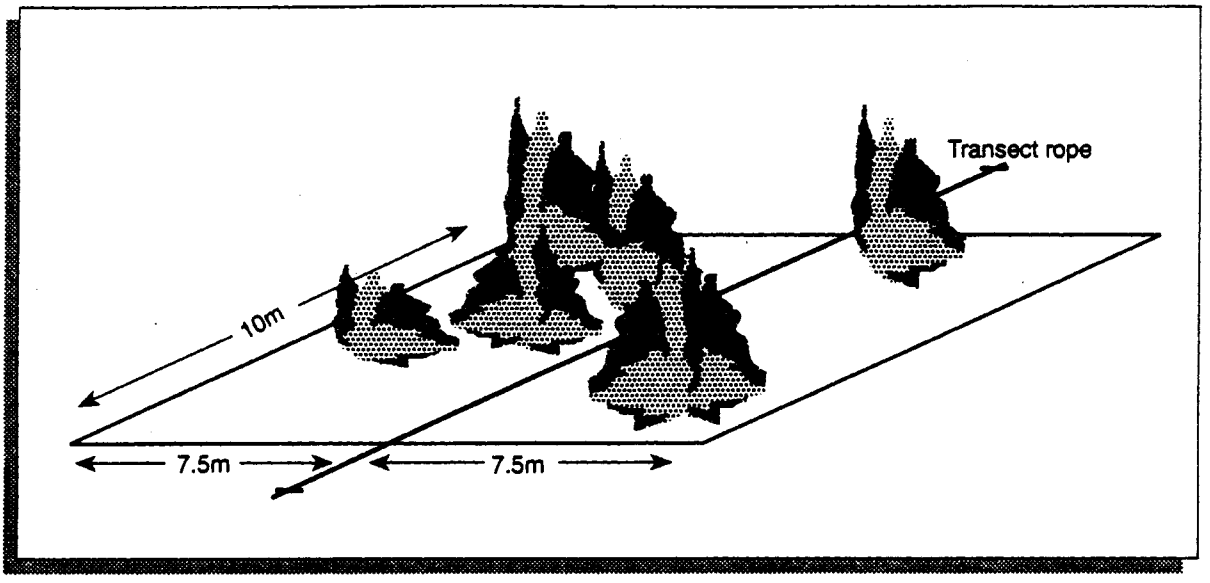


Figure 4. Count the clumps of stems in the 10 x 15 m area for the shrubs Multiflora Rose, European High-bush Cranberry, the Buckthorns, and the Honeysuckles.

Repeat this procedure for all species -- Garlic Mustard, Rocket, European High-bush Cranberry, Multiflora Rose, Buckthorn, Honeysuckle -- in each 10 m segment of the transect.

4. If you have enough time, repeat these procedures on another transect. Ask your teacher which transect would be most useful for you to work on next.

5. Turn in the tools and data sheet. Congratulations, you are done with this protocol! Plan on preparing your data for submission to the Illinois ForestWatch coordinator.

Task Checklist: Part 2, Protocol 2a

Use this checklist to make sure that you have completed all of the tasks in the protocol.

Everyone should...

- ❑ Read all of the steps in the procedure and take on the various roles.
- ❑ Gather the materials needed to complete the protocol.

The Facilitator should...

- ❑ Help everyone to complete their tasks and keep them focused on the tasks.

The Recorder should...

- ❑ Make sure that all of the data is gathered and legibly recorded.

The Botanist for Garlic Mustard and Rocket should...

- ❑ Document the presence or absence of Garlic Mustard and Rocket in each 10 m segment of the transect.
- ❑ Determine the density of Garlic Mustard and Rocket, if they are present.

The Botanist for European High-bush Cranberry and Multiflora Rose should...

- ❑ Document the presence or absence of European High-bush Cranberry and Multiflora Rose in each 10 m segment of the transect.
- ❑ Determine the density of European High-bush Cranberry and Multiflora Rose, if they are present.

The Botanist for Buckthorn and Honeysuckle should...

- ❑ Document the presence or absence of Buckthorn and Honeysuckle in each 10 m segment of the transect.
- ❑ Determine the density of Buckthorn and Honeysuckle, if they are present.

After completing the protocol, everyone should...

- ❑ Prepare the data for submission to the ForestWatch Coordinator.

Data Sheet: Part 2, Protocol 2a

Date	

Name	Role
1.	
2.	
3.	
4.	
5.	

Site Location	
County:	
Township Name:	
Township (ex. T12S):	
Range (ex. R4W):	
Section Number:	
Transect Letter	

Mark whether each species is Present (Y for Yes and N for No) in each 10 m long by 15 m wide segment of the transect.

For those species that are present in a 10 m segment, estimate the density.

For Garlic Mustard and Rocket --
If there are less than 100 individuals within a meter of either side of the transect line, record the number of individuals. If there are more than 100 individuals, then record the area that contains only 100 individuals.

For High-bush Cranberry, Multiflora Rose, Buckthorn, and Honeysuckle --
Count the number of clumps in the 10 x 15 m patch centered on the transect line.

0 - 10 m	Present?	Number or Area	
Garlic Mustard	Y or N		
Rocket	Y or N		
High-bush Cranberry	Y or N		
Multiflora Rose	Y or N		
Buckthorn	Y or N		
Honeysuckle	Y or N		

10 - 20 m	Present?	Number	or	Area
Garlic Mustard	Y or N			
Rocket	Y or N			
High-bush Cranberry	Y or N			
Multiflora Rose	Y or N			
Buckthorn	Y or N			
Honeysuckle	Y or N			

20 - 30 m	Present?	Number	or	Area
Garlic Mustard	Y or N			
Rocket	Y or N			
High-bush Cranberry	Y or N			
Multiflora Rose	Y or N			
Buckthorn	Y or N			
Honeysuckle	Y or N			

30 - 40 m	Present?	Number	or	Area
Garlic Mustard	Y or N			
Rocket	Y or N			
High-bush Cranberry	Y or N			
Multiflora Rose	Y or N			
Buckthorn	Y or N			
Honeysuckle	Y or N			

40 - 50 m	Present?	Number	or	Area
Garlic Mustard	Y or N			
Rocket	Y or N			
High-bush Cranberry	Y or N			
Multiflora Rose	Y or N			
Buckthorn	Y or N			
Honeysuckle	Y or N			

50 - 60 m	Present?	Number	or	Area
Garlic Mustard	Y or N			
Rocket	Y or N			
High-bush Cranberry	Y or N			
Multiflora Rose	Y or N			
Buckthorn	Y or N			
Honeysuckle	Y or N			

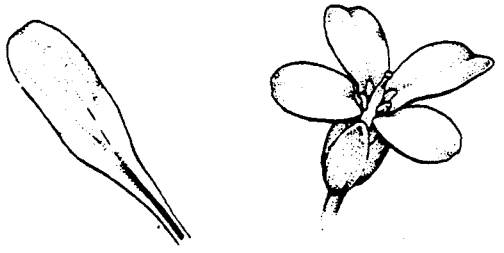
60 - 70 m	Present?	Number	or	Area
Garlic Mustard	Y or N			
Rocket	Y or N			
High-bush Cranberry	Y or N			
Multiflora Rose	Y or N			
Buckthorn	Y or N			
Honeysuckle	Y or N			

70 - 80 m	Present?	Number	or	Area
Garlic Mustard	Y or N			
Rocket	Y or N			
High-bush Cranberry	Y or N			
Multiflora Rose	Y or N			
Buckthorn	Y or N			
Honeysuckle	Y or N			

80 - 90 m	Present?	Number	or	Area
Garlic Mustard	Y or N			
Rocket	Y or N			
High-bush Cranberry	Y or N			
Multiflora Rose	Y or N			
Buckthorn	Y or N			
Honeysuckle	Y or N			

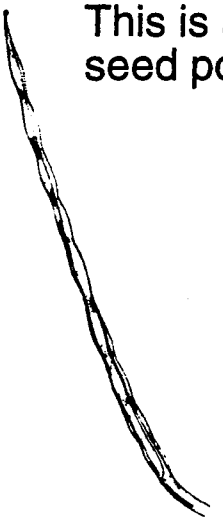
90 - 100 m	Present?	Number	or	Area
Garlic Mustard	Y or N			
Rocket	Y or N			
High-bush Cranberry	Y or N			
Multiflora Rose	Y or N			
Buckthorn	Y or N			
Honeysuckle	Y or N			

Garlic Mustard (*Alliaria petiolata*) Reference Card



4 white petals.

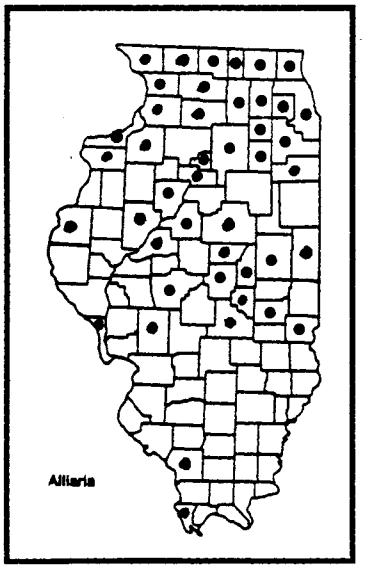
Petals 5 - 9 mm long.
⟷ This arrow is approximately 10 mm long.

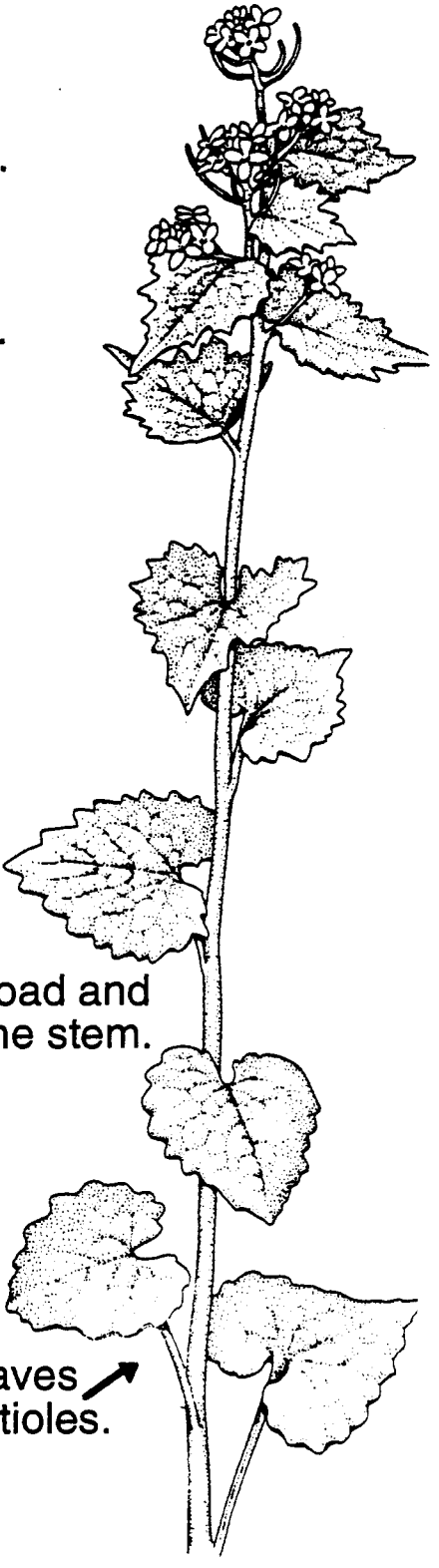


This is a seed pod.

Plants smell like garlic!

Up to 1 m tall.



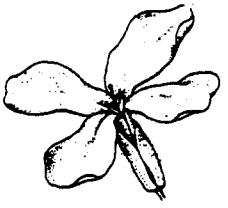


Leaves are broad and do not clasp the stem.

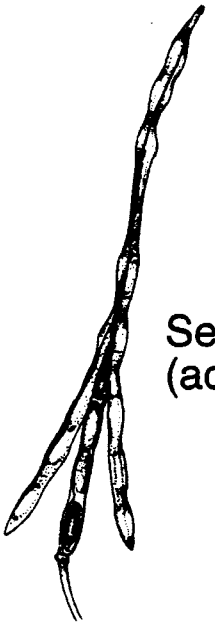
The lower leaves have long petioles.

Rocket (*Hesperis matronalis*) Reference Card

Plant in silhouette.

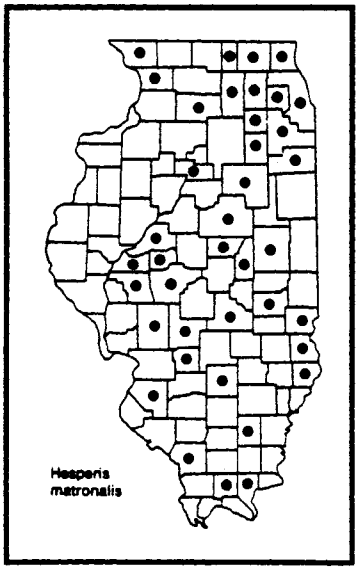


4 purplish petals.



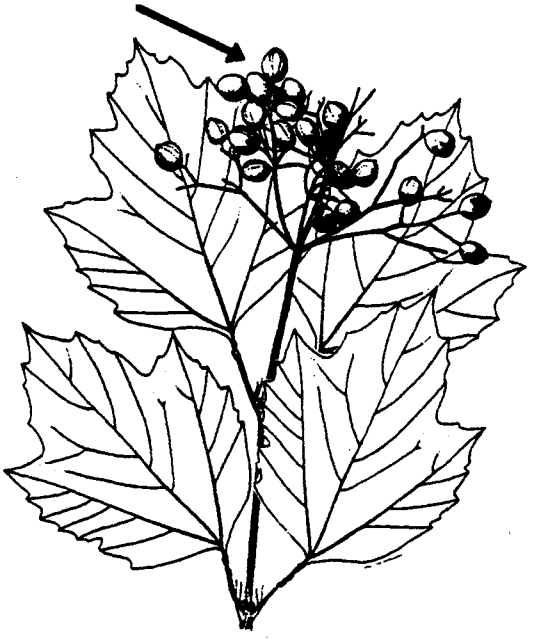
Seed pod (actual size).

Tapering leaves on short petioles (actual size).



European High-bush Cranberry (*Viburnum opulus*) Reference Card

Bright red berries.

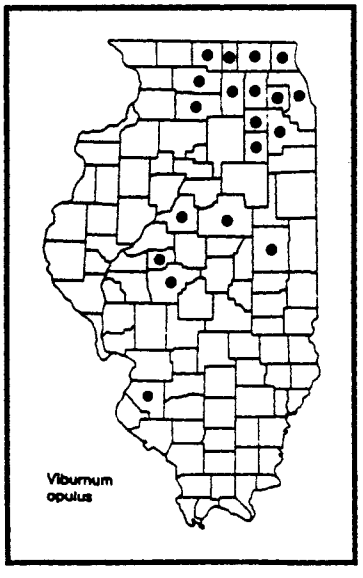


A shrub, 1 - 4 m high.

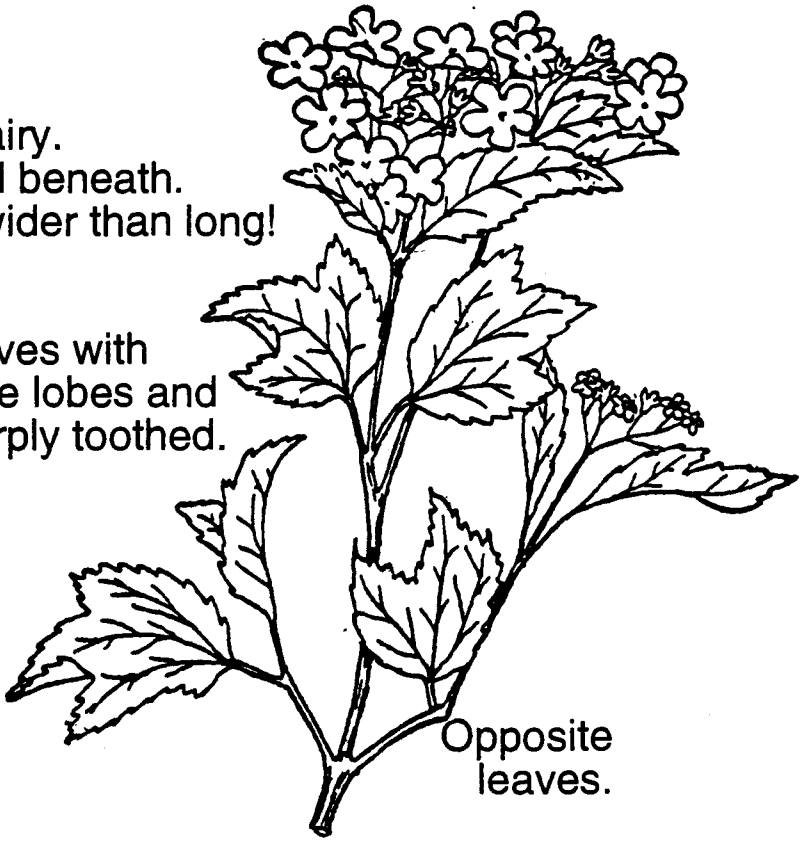
Flowers with five lobes.

Whitish flowers.

Small branches not hairy.
Leaves not dotted beneath.
Leaves are wider than long!

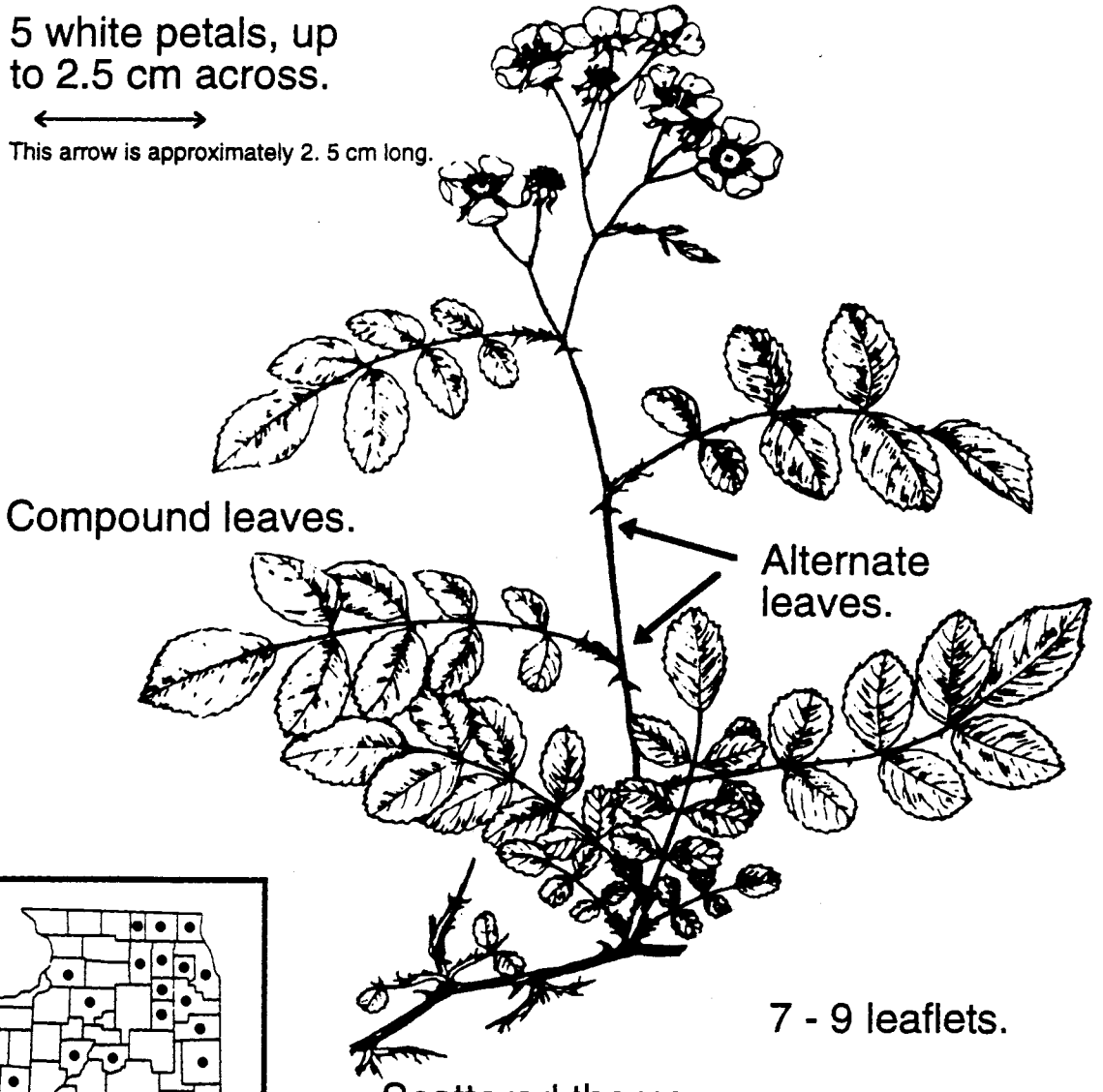


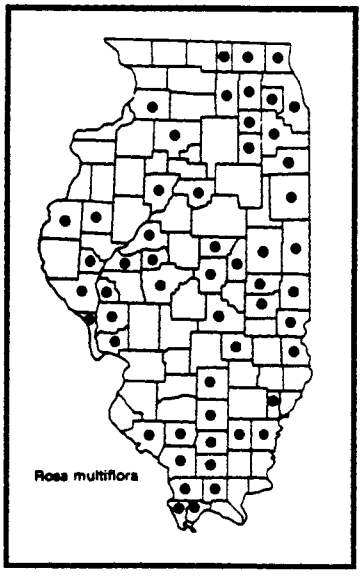
Leaves with three lobes and sharply toothed.



Opposite leaves.

Multiflora Rose (*Rosa multiflora*) Reference Card

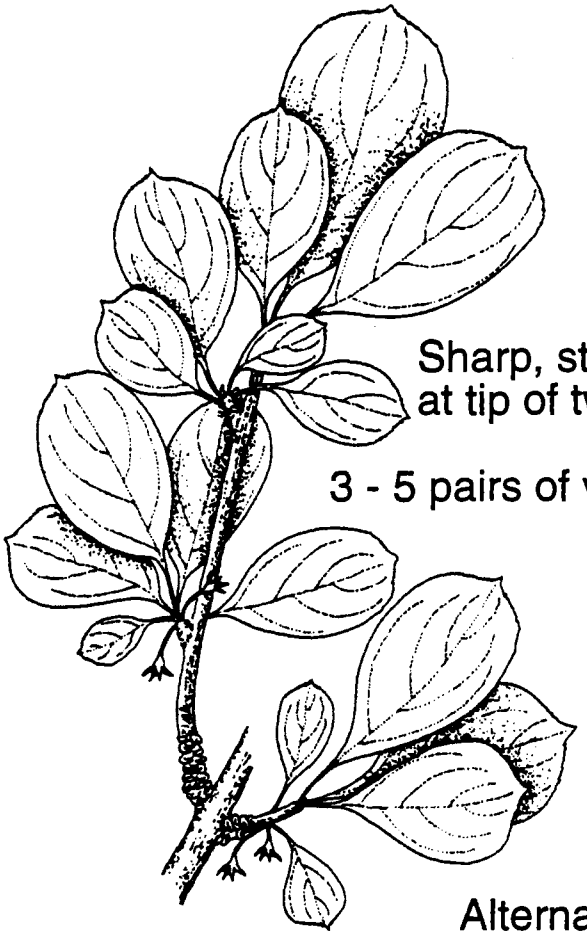




Buckthorn (*Rhamnus spp.*) Reference Card

Buckthorn is a genus that includes two species:

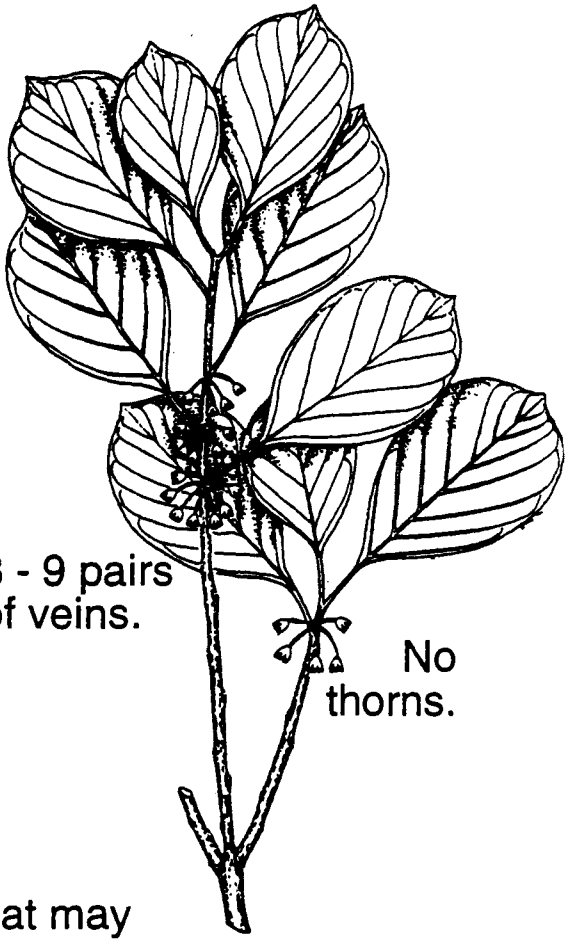
Common Buckthorn



Sharp, stout thorns at tip of twigs.

3 - 5 pairs of veins.

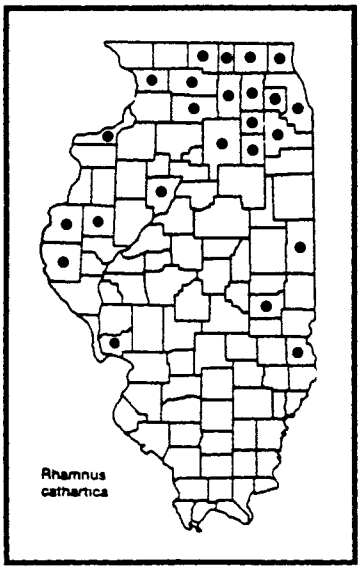
Glossy Buckthorn

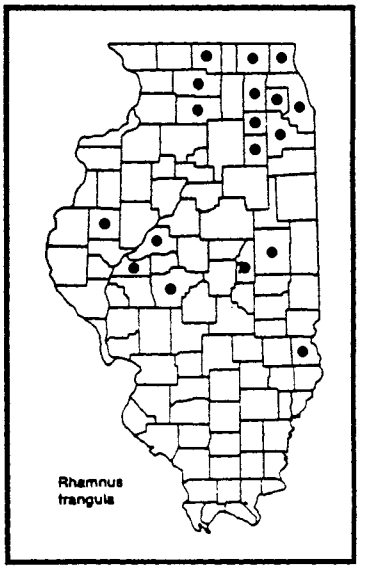


8 - 9 pairs of veins.

No thorns.

Alternate leaves that may look opposite because they are close together.



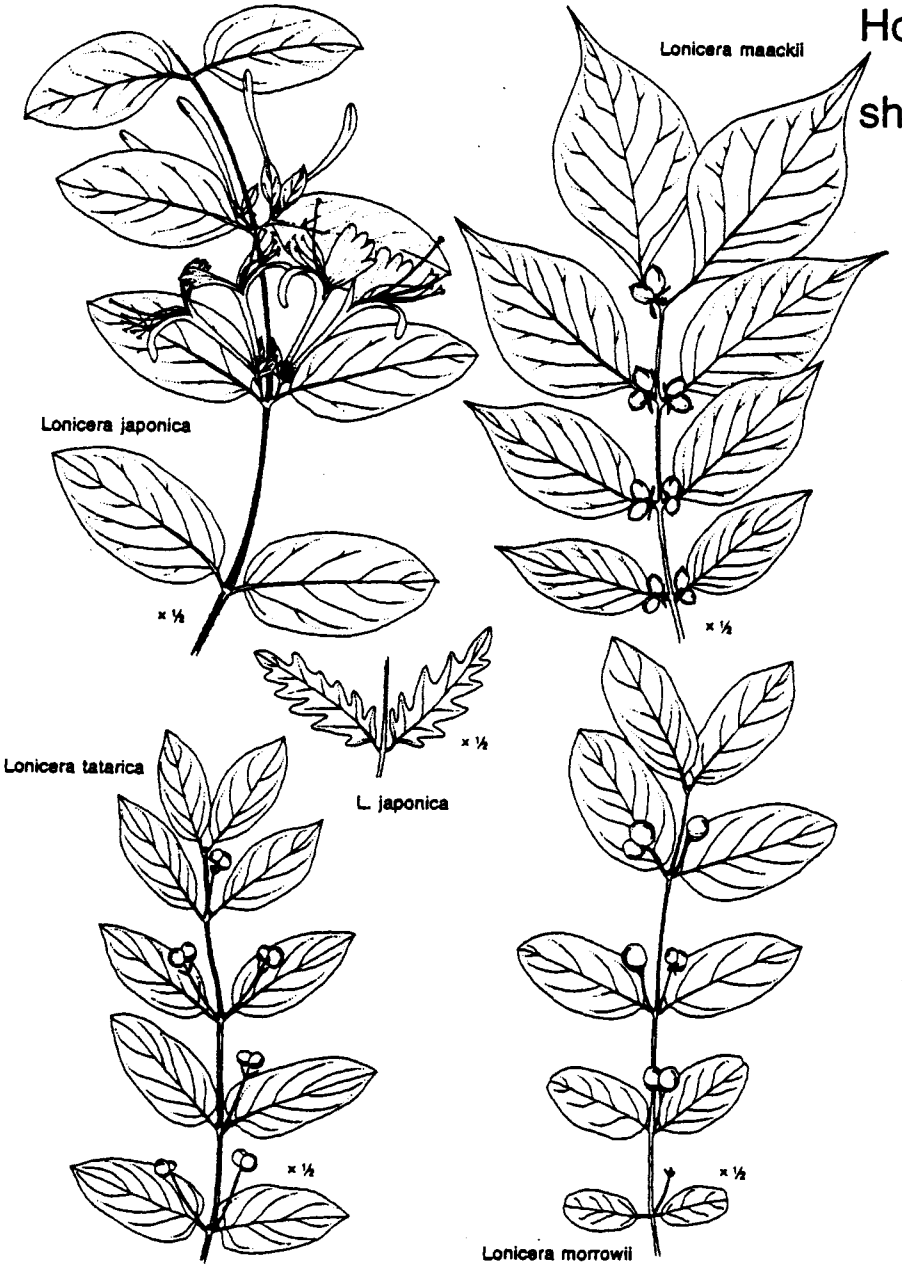


Both species...

- Small tree or shrub.
- Alternate leaves.
- Entire leaves.
- Leaves without lobes.
- Berry-like fruit.

Honeysuckle (*Lonicera spp.*) Reference Card

Honeysuckle is a genus which includes many species of plants. Some species are pictured here. All have these common characteristics

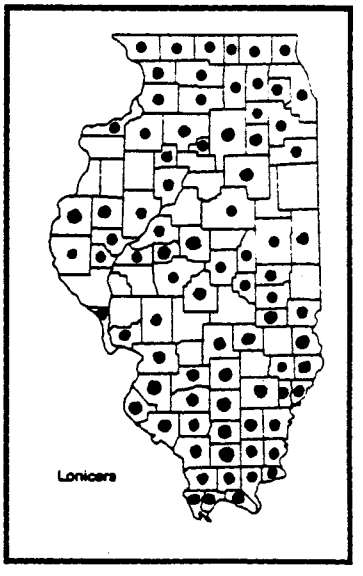


Honeysuckles may be small trees, shrubs, or climbing vines.

Leaves are opposite.

Leaves have an entirely smooth edge.

Berries have several seeds.



Title: Part 2, Protocol 2b -- Evaluating vegetative complexity.

Question: What is the distribution and abundance of the understory vegetation, woody debris, and duff in the forest?

Goal: To detect changes in the structure of the lower portions of the forest which reflect changes in habitat for many creatures.

Purpose: In this protocol, you will examine and quantify both the living and non-living woody vegetation in the lower portions of the forest.

One portion of dead forest vegetation is called "downed woody debris" and consists of the dead twigs, branches, stems, and trunks of trees that have fallen to the ground. Many people think that this dead wood is merely something that should be cleaned up or burned out. Actually, it is an important part of the forest ecosystem because it is used by many species for both shelter and food. Anyone who has ever turned over a downed log and seen the creatures living under it, the fine threads of fungus growing throughout it, or the young seedlings of new trees emerging from the decaying wood, knows this.

Another portion of the dead vegetation in the forest is the "duff". Duff consists of the top layer of the forest floor where needles, leaves and other tree and shrub parts decompose. This, too, is home to many organisms including soil arthropods and fungus which help recycle nutrients in the forest by breaking down the dead material and releasing it to the soil where living plants can absorb the nutrients through their roots.

The living portion of the forest is just as important to the functioning of the forest ecosystem. Many creatures depend on the lower portions of the forest to provide the habitat they need to survive. For example, forest birds need places to forage, perch, sleep, and nest. Though some manage to do these activities on the ground, many species prefer to be in the lower levels of the forest canopy which is out of reach of the predators which roam the forest floor.

Materials:

110 m rope knotted at 10 m intervals

For Downed Woody Debris --
- Meter Stick marked at 5, 12.5, 25, 50, 75 cm
- Garden Trowel
- Downed Woody Debris Data Sheet
- Clipboard
- Pencil

For Understory Vegetation Structure --
- 10 m rope
- Tent Stake
- Mallet
- Large Nail
- Density Board
- Meter Stick
- Understory Vegetation Data Sheet
- Clipboard
- Pencil

Procedure:

1. Read all of the steps in the procedure and assign members in your group the following roles. If you don't have five people in your group, you may take on more than one role. Alternatively, your teacher may wish to assign you to a specific role or two. The roles are:

Facilitator -- One person who makes sure that the group quickly and accurately completes the protocol by having individuals fulfill their particular tasks. Also makes sure that all of the data sheets are filled out legibly and completely.

Woody Debris Technicians -- Two people who tally the amount of downed woody debris along the whole transect and measure the depth of the duff at ten points along the transect .

Understory Vegetation Technicians -- Two people who quantify the density of the understory vegetation at three different heights at five points along the transect.

2. Gather the materials listed above for your group. Locate your transect and run a rope that is knotted every 10 m between the stakes which mark its beginning and end. (You may have already done this.) Alternatively, you may use a 100 m measuring tape.

3. The Woody Debris Technicians are responsible for characterizing the amount of downed woody debris along the transect. They count all of the pieces of downed wood which are greater than 5 cm in diameter. They also measure the depth of the duff at two locations within each of five sampling points.

Define the sampling plane --

You will be counting and measuring all of the pieces of downed wood which cross what biologists call a "sampling plane." You can imagine your sampling plane to be a huge glass wall that rises to the sky from the transect line. You will count all of the dead wood that crosses this imaginary glass wall. See Figure 1.

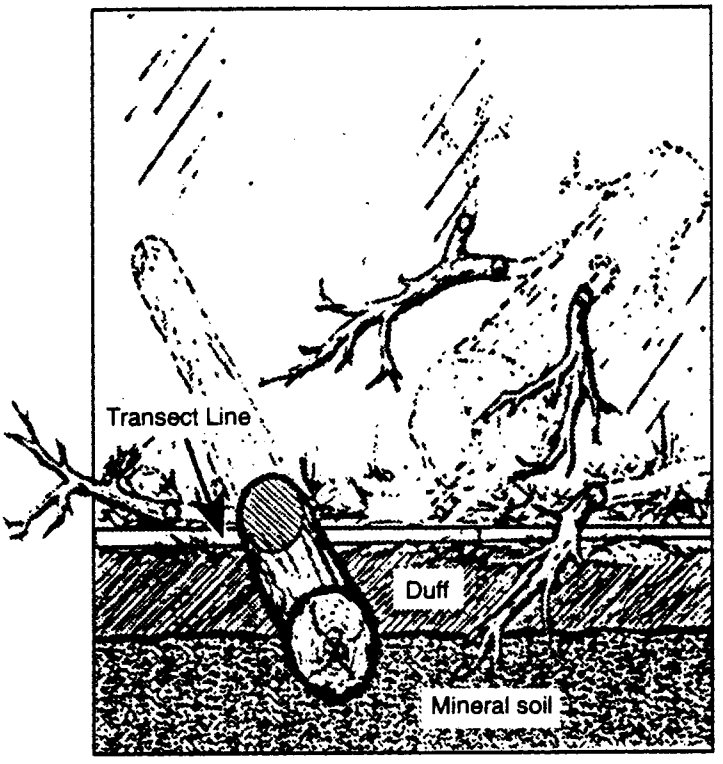


Figure 1. You can think of the sampling plane as a huge glass wall rising from the transect line.

Tally the pieces of wood that cross the sampling plane --

Record the number of pieces of wood that cross the imaginary glass wall in each 10 m segment of the transect on the Downed Woody Debris Data Sheet. You will tally them according to the following size classes:

Size Class:
- 5 - 12.5 cm in diameter
- 12.5 - 25 cm in diameter
- 25 - 50 cm in diameter
- 50 - 75 cm in diameter
- greater than 75 cm in diameter

You can easily tell if a stick falls into any of these classes by using a meter stick which has tape marks at 5, 12.5, 25, 50, and 75 cm. Make sure that you are accurately reading the meter stick and avoiding problems with parallax. Parallax refers to the problem of making an accurate reading if you are trying to measure something at an angle. In this case, make sure that you line up the end of the meter stick with the edge of the tree for your first sighting, then shift your head so that your line of sight on the far side of the tree is parallel to your first line of sight. This way, your measurement of the diameter of the downed wood will be more accurate. Check out Figure 2.

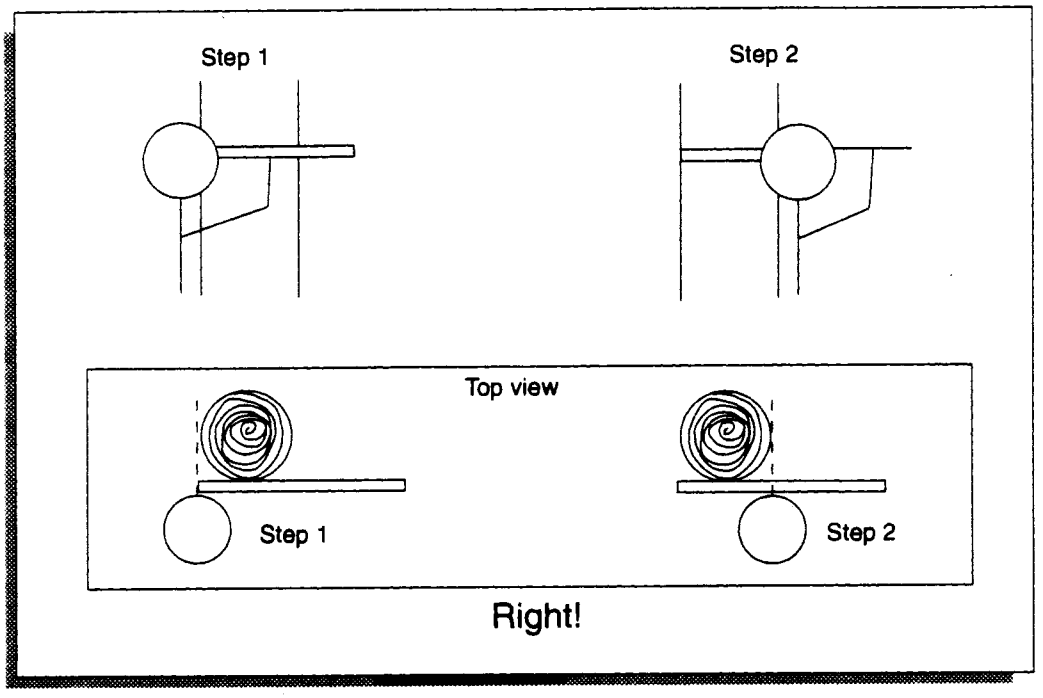


Figure 2. Avoid problems with parallax by making sure that the two lines of sighting are parallel.

When you measure the wood, make sure that you measure the downed piece at the point where it crosses the transect line. Also, measure the diameter so that it is perpendicular to the piece of wood. Check out Figure 3.

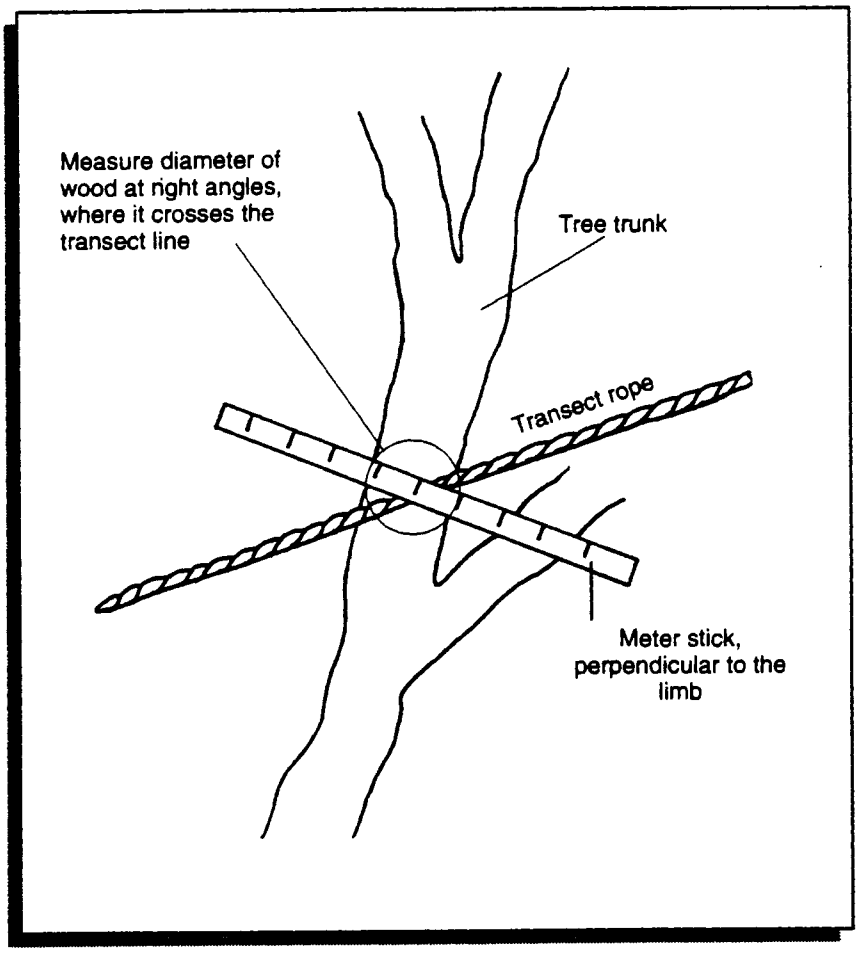


Figure 3. Measure the downed wood where it crosses the sampling plane and at right angles to the main axis of the piece of wood.

You should tally rotten and sound wood separately. A piece of wood is rotten if it is obviously punky (squishy or soft) or can be kicked apart (but don't kick it apart, it is some organism's habitat!). Another test to see if it is rotten is if you can use your bare hand to push a nail into almost any part of the log.

Repeat this procedure for each 10 m segment of the transect.

Measure vertical depth of duff --

Find the 10 m mark on the transect and measure the depth of the duff to the nearest 0.5 cm at 2 and 4 m in any direction from that point along the transect.

Duff is the fermentation and humus layers of the forest floor. It does not include the freshly cast material in the litter layer. The top of the duff is where needles, leaves, and other vegetative material noticeably begin to decompose. Individual particles usually will be bound by a fine network of white hair-like structures that are the main growing body of fungi on the forest floor which are called "fungal mycelium." When moss is present, the top of the duff is just below the green part of the moss. The bottom of the duff is the mineral soil.

Use a garden trowel to carefully cut through the duff in order to expose the duff profile. That way, you will be able to measure it easily. See Figure 4.

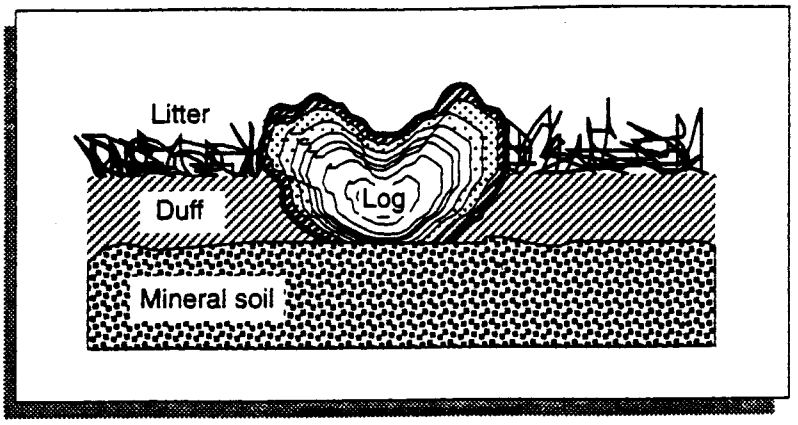


Figure 4. The duff is the top layer of the forest floor where organic matter decomposes.

Repeat measuring the depth of the duff at the 30, 50, 70, and 90 m marks along the transect.

4. Understory Vegetation Technicians are responsible for characterizing the living understory vegetation in the forest. You will estimate the shrub density in the understory as well as the foliage volume.

Locate your sampling point --

Go to the 20 m point on your transect line. Use the tent stake to anchor one end of the 10 m rope at the 20 m mark. You will be using the rope to establish the distance for the four directions in which you sample shrub density and foliage volume. See Figure 5.

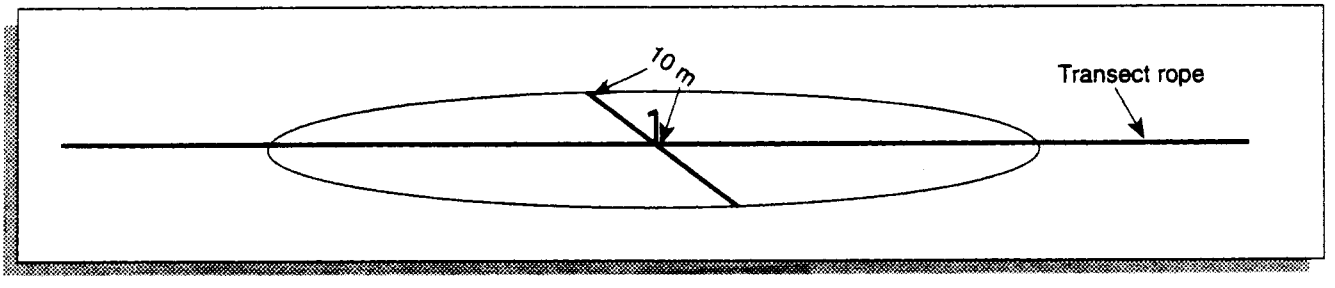


Figure 5. Use the 10 m rope as a guide when sampling in the four directions from the tent stake.

If a large tree blocks one of the four directions, you may have to move the stake a meter or two up the transect line from the 20 m point.

Estimate the shrub density --

First, stretch the 10 m rope from the tent stake out along the transect line, then walk along the rope with your arms outstretched. Count the number of stems of shrubs that touch your arms and chest as you walk.

Shrubs are woody plants with many stems. They do not reach the canopy and they never will, even as mature shrubs. Do not count young trees, or saplings, that reach will reach into the overstory when they are mature. Count only the stems of shrubs that are larger than 3 cm in diameter. Record the number.

Do the same for the other three directions of your sampling cross. See Figure 6. Make sure that you don't count any shrub stems twice (especially those near the tent stake).

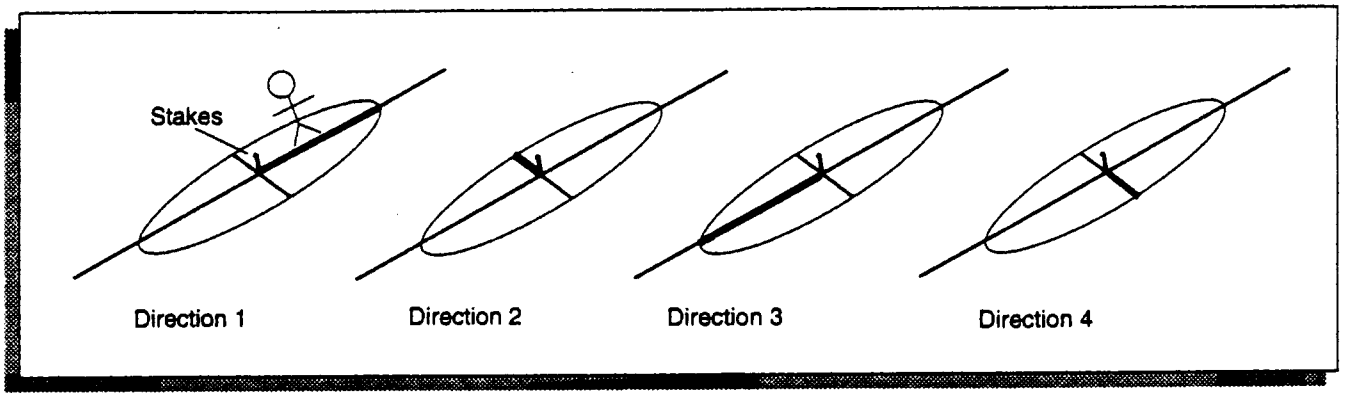


Figure 6. Estimate the stem density by walking in the four directions shown with your arms outstretched and counting the number of stems that touch your arms.

Record the total number of stems you have touched. The total number of contacts made in the four directions (each 10 m long) multiplied by 140 gives an estimate of the number of shrub stems per ha.

WARNING! Make sure that you don't run into any poison ivy and poison sumac when you do this exercise. If you don't know how to identify them, ask your teacher.

Estimate the foliage volume with a density board --

Make a density board out of foam-core from the specifications in Figure 7. (You probably want to do this before you get out into the field.)

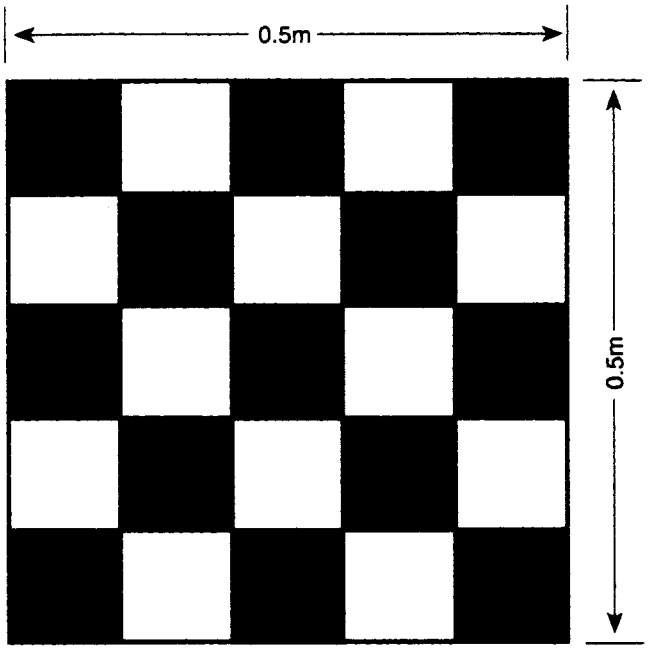


Figure 7. The density board should be a checkerboard that measures 0.5 m on a side and has black and white squares that are 10 cm on a side.

Have one person stand at the 20 m point on the transect. Have another person take the density board to the end of the 10 m rope and hold it with one edge on the ground facing the person at the 20 m point. See Figure 8. The person at the 20 m point should crouch and count the number of squares that they can see which are more than 50 percent visible (not blocked by vegetation). Record the number.

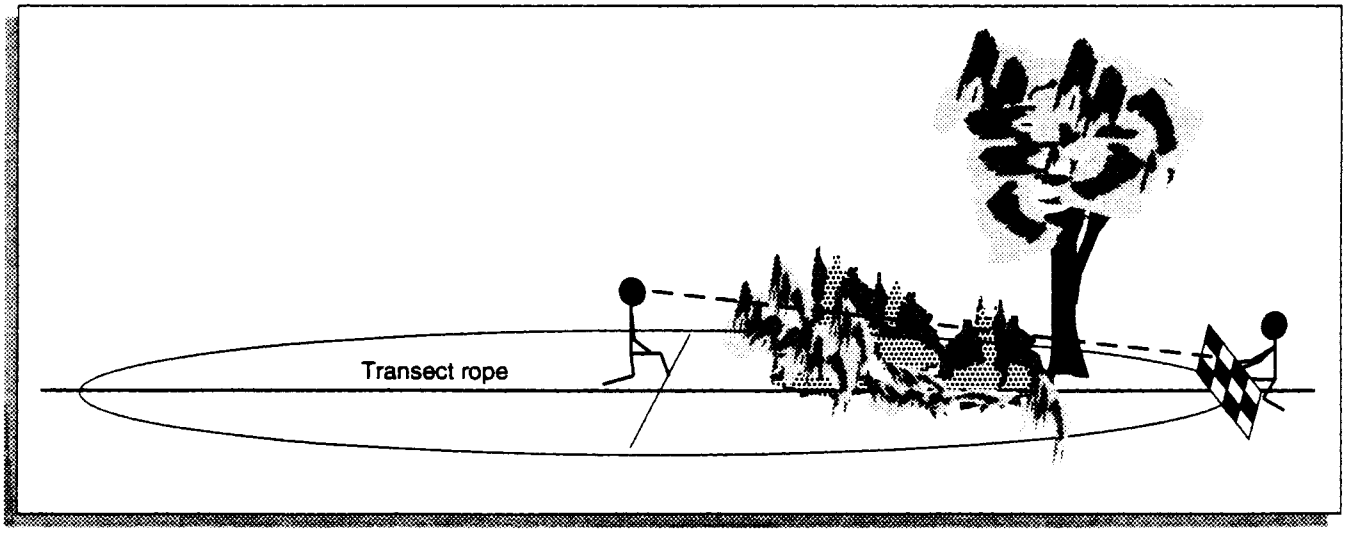


Figure 8. Be sure to crouch when you are checking the visibility at ground level.

Repeat this, but hold the density board so that its bottom edge is 1 m off of the ground (You can use the meter stick for this). Count the squares that are visible and record the number. The counter may stand upright for this and the next measurement.

Repeat this again, but hold the board overhead, preferably 2 m above ground level. Record the answer.

Do this whole procedure (Counting squares visible at 0, 1, and 2 m high) for the other three directions from the 20 m mark and record the numbers.

Repeat this whole procedure (Step 4) at the 40, 60, 80, and 100 m points along the transect! If you are clever, you should be able to combine counting the number of shrub stems along one direction with estimating the foliage volume.

5. If you have enough time, repeat these procedures on another transect. Ask your teacher which transect would be most useful for you to work on next.

6. Turn in the tools and data sheet. Congratulations, you are done with this protocol! Plan on preparing your data for submission to the Illinois ForestWatch coordinator.

Task Checklist: Part 2, Protocol 2b

Use this checklist to make sure that you have completed all of the tasks in the protocol.

Everyone should...

- ❑ Read all of the steps in the procedure and take on the various roles.
- ❑ Gather the materials needed to complete the protocol.

The Facilitator should...

- ❑ Help everyone to complete their tasks and keep them focused on the tasks.
- ❑ Make sure that all of the data is gathered and legibly recorded.

The Woody Debris Technicians should...

- ❑ Define the sampling plane.
- ❑ Tally the pieces of wood that cross the sampling plane and repeat this for each 10 m segment of the transect.
- ❑ Measure vertical depth of duff.
- ❑ Repeat these steps at the 30, 50, 70, and 90 m marks along the transect.

The Understory Vegetation Technicians should...

- ❑ Locate your sampling point.
- ❑ Estimate the shrub density.
- ❑ Estimate the foliage volume with a density board.
- ❑ Repeat these steps at the 40, 60, 80, and 100 m points along the transect.

After completing the protocol, everyone should...

- ❑ Prepare the data for submission to the ForestWatch Coordinator

Data Sheet: Vegetative Complexity Part 2, Protocol 2b

Date	

Name	Role
1.	
2.	
3.	
4.	
5.	

Site Location	
County:	
Township Name:	
Township (ex. T12S):	
Range (ex. R4W):	
Section Number:	
Transect Letter	

Downed Woody Debris Data Sheet: Part 2, Protocol 2b

Tally, according to diameter, the number of sound and rotten pieces of wood which cross the sampling plane along the transect line.

Segment		Size Class				
		5 - 12.5	12.5 - 25	25 - 50	50 - 75	> 75 cm
0 - 10 m	sound					
	rotten					
10 - 20 m	sound					
	rotten					
20 - 30 m	sound					
	rotten					
30 - 40 m	sound					
	rotten					
40 - 50 m	sound					
	rotten					
50 - 60 m	sound					
	rotten					
60 - 70 m	sound					
	rotten					
70 - 80 m	sound					
	rotten					
80 - 90 m	sound					
	rotten					
90 - 100 m	sound					
	rotten					

Record the depth of the duff to the nearest 0.5 cm.

Point on Transect	Depth 2 m from point	Depth 4 m from point
10 m		
30 m		
50 m		
70 m		
90 m		

Understory Vegetation Data Sheet: Part 2, Protocol 2b

Count the number of squares that you can see -- those that are more than 50 percent visible on the density board. Also, count the number of stems of shrubs touched in the four directions.

20 m Sampling Point		Direction from Sampling Point			
		Direction 1	Direction 2	Direction 3	Direction 4
Height of Board	0 m				
	1 m				
	2 m				
Stems Touched					

40 m Sampling Point		Direction from Sampling Point			
		Direction 1	Direction 2	Direction 3	Direction 4
Height of Board	0 m				
	1 m				
	2 m				
Stems Touched					

60 m Sampling Point		Direction from Sampling Point			
		Direction 1	Direction 2	Direction 3	Direction 4
Height of Board	0 m				
	1 m				
	2 m				
Stems Touched					

80 m Sampling Point		Direction from Sampling Point			
		Direction 1	Direction 2	Direction 3	Direction 4
Height of Board	0 m				
	1 m				
	2 m				
Stems Touched					

100 m Sampling Point		Direction from Sampling Point			
		Direction 1	Direction 2	Direction 3	Direction 4
Height of Board	0 m				
	1 m				
	2 m				
Stems Touched					

Title: Part 2, Protocol 2c -- Sampling animal life.

Question: What is the abundance of a few selected indicator taxa of animals?

Goal: To detect changes in the abundance of snakes, salamanders, and spiders in the forest.

Purpose: Certain groups of animals reflect general or specific aspects of woodland health with their presence or absence, abundance, and diversity.

Amphibians (frogs and salamanders) tend to be very sensitive to disturbance or pollution, and are most commonly encountered in relatively unpolluted habitats. Snakes, which are predators, often reflect the presence of their prey which differs between snake species. Spiders, which are predators as well, depend on insects in the forests as their source of food.

By keeping track of changes in the numbers of these groups of animals, it may be possible to detect deterioration or improvement in the forest ecosystem at the higher levels in the "food chain."

Materials:

110 m rope knotted at 10 m intervals (or 100 m measuring tape)
12 Plywood Sampling Boards (1/2-inch thick) with attached handles
Thermometer to measure air temperature
Umbrella (preferably white or black)
Map of Transects
Reptile and Amphibian Field Guide
Snake and Salamander Data Sheet
Spider Data Sheets
Guide to the Common Snakes and Salamanders of Illinois Forests
Clipboard
Pencil

Procedure:

1. Read all of the steps in the procedure and assign members in your group the following roles. If you don't have five people in your group, you may take on more than one role. Alternatively, your teacher may wish to assign you to a specific role or two. The roles are:

Facilitator -- One person who makes sure that the group quickly and accurately completes the protocol by having individuals fulfill their particular tasks. Also makes sure that all of the data sheets are filled out legibly and completely.

Snake and Salamander Technicians -- Two people who identify the species of snakes and salamanders under the sampling boards and identify them to species.

Spider Technicians -- Two people who count spider webs along the transect and sample spiders in the understory by shaking them out onto an upturned umbrella.

2. Gather the materials listed above for your group. Locate your transect and run a rope that is knotted every 10 m between the stakes that mark its beginning and end. (You may have already done this.) Alternatively, you may use a 100 m measuring tape.

3. The Snake and Salamander Technicians are responsible for finding all of the snake and salamander sampling boards at the site, turning them over, and counting and identifying any snakes and salamanders that they find under the boards.

Set out the sampling boards --

If this is the first year that your class has worked at this site, you will have to make the sampling boards and set them out on the transects.

Obtain plywood and construct 12 sampling boards. These should be 2' x 2'. Make sure all the boards are the same. Attach handles to the top side, near one edge. Do not paint them, but you should number them with permanent marker. See Figure 1.

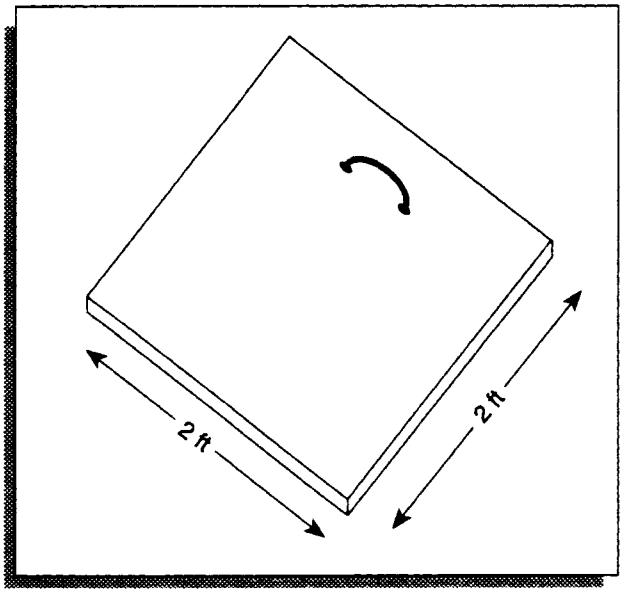


Figure 1. Plywood boards provide a suitable microhabitat for amphibians and reptiles. Its standard size allows you to compare what you find under different boards at your site as well as what other students find at additional monitoring sites.

Sampling boards are set out the first year, and surveyed in following years (depending on the quality of the plywood, boards may only last 3-4 years before they need to be replaced, but boards must "weather" at least a year before animals will start to live underneath). Boards should be numbered for reference and placed near the start and end of all of the transects (and marked on a map). See Figure 2.

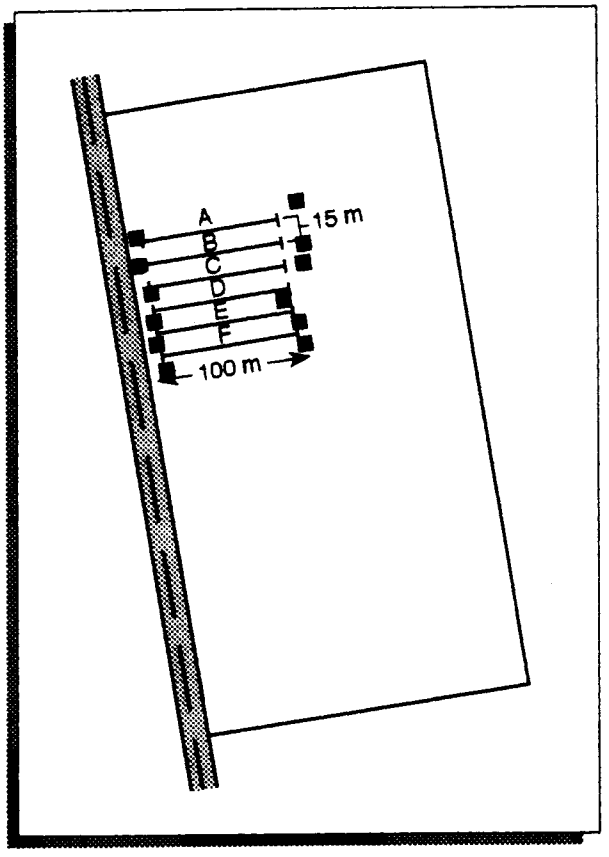


Figure 2. Place a board at the beginning and end of each transect. If necessary, make notes so that other students can find the boards next year.

The specific location should be far enough from the transect that the boards will not interfere with vegetation surveys, and preferably over a relatively flat patch of ground that has some leaf litter but doesn't have saplings growing on it. You may need to hunt around a bit to find a suitable spot, just make sure the boards can be found in future years. As always, be sure the property owner is aware that you're leaving these boards there.

Checking the sampling boards annually --

If the sampling boards have already been set out for a year, you will check each board to see if snakes and salamanders are living under it.

Each monitoring period, visit each sampling board. Use the handles to lift the board from behind. This will reduce the likelihood of startling the animals underneath (or the person lifting the board).

Identifying species --

Ideally, you should be able to identify any snakes or salamanders without having to handle them. There are few enough species in Illinois that this should be possible in most cases. Remember, some snakes are venomous and these species tend to be found in the southern part of the state. This is another reason we urge you not to handle animals.

Unless someone in the group is an experienced herpetologist, it is essential to have a good field guide to identify snakes and salamanders. If you have difficulty identifying a species initially, try to record some general notes about its appearance, such as size, color pattern and texture. This will reduce the number of possibilities for anyone helping you identify them later. The most common species you are likely to encounter are described in the "Guide to the Common Snakes and Salamanders of Illinois Forests".

For each sampling board, record the identity and number of all species encountered. Also, describe the conditions beneath the board as "dry" "damp" or "wet", in case there is year-to-year variation (salamanders are unlikely to be present unless the ground is wet).

Place the board back down gently -- a sudden drop could injure the animals underneath. Once a board is in place, it should be left undisturbed as much as possible.

4. The Spider Technicians are responsible for counting the webs of orb-weaving spiders along the transect and for sampling the abundance of all spiders by shaking bushes over an upturned umbrella.

Counting spider webs --

You will count the number of spider webs that you can find in each 10 m segment of the transect in a path that is 2 m wide and 7.5 m to the right or left of the transect line. Because you may have already destroyed many of the spider webs near your transect line when you were surveying the trees in the forest, you will have to go to the edges of your transect -- 7.5 m to either side of the line.

Start at the 0 m mark of your transect. Go 7.5 m to your right which is halfway between your transect line and the transect line of the group on the right side of you. Face into the forest. You will count all of the spider webs that you find in a 2 m wide path up to the 10 m point on your transect. You can judge the width of the path by putting your arms out to your sides or by using a meter stick.

Count only those webs that are spun by the orb-weaving spiders. Orb-webs are the 'traditional' spider webs that kids like to draw. They are usually vertical with concentric rings and are made to trap flying insects. Don't count cobwebs or funnel webs which are also made by spiders but harder to find. Be sure to search low to the ground as well as under bushes. Take a look at Figure 3. Record your data.

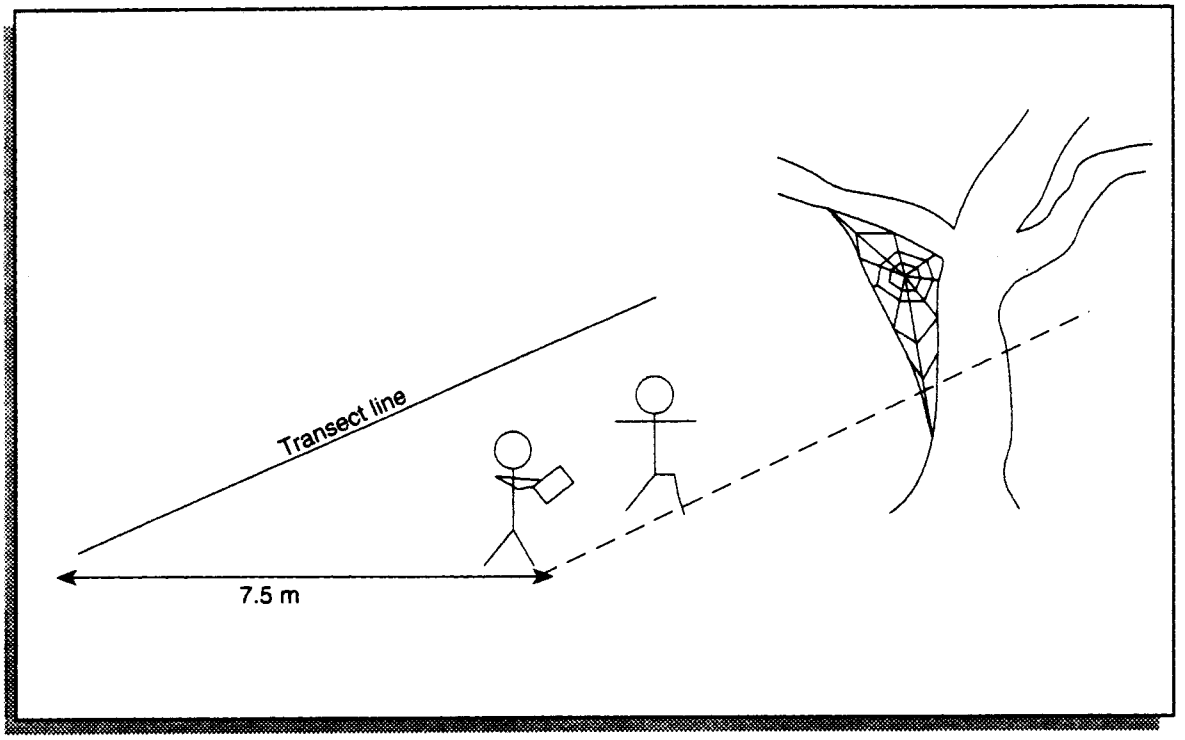


Figure 3. Count all of the orb webs in each 10 m segment of your transect in a 2 m wide path located 7.5 m to the side of your transect line.

Follow these steps on the left side of your transect line and then repeat the whole procedure for each 10 m segment of your transect.

Sampling spider abundance --

Once you have counted the number of spider webs along your transect, you need to sample the abundance of all spiders in the forest.

At the 100 m mark, pick a nearby shrub or small tree with lots of low down vegetation on it. Open your umbrella, turn it upside down, and place it under that shrub or tree. Now give the shrub or tree a few good shakes. Many things should fall onto the umbrella including insects, leaves, twigs, and spiders. Crouch down and count the *total number* of spiders that you see as well as the number of *types* of spiders. If you aren't sure if you are looking at a spider or an insect, count the number of legs. Spiders have eight legs (and only two major parts of their body) while insects have six legs (and three major parts to their body). Don't count Harvestmen which look like spiders but aren't spiders. They have eight legs, but have only one body part.

Clean out your umbrella and repeat this procedure at the 80, 60, 40, 20, and 0 m points along your transect.

5. If you have enough time, repeat these procedures on another transect. Ask your teacher which transect would be most useful for you to work on next.

6. Turn in the tools and data sheet. Congratulations, you are done with this protocol! Plan on preparing your data for submission to the Illinois ForestWatch coordinator.

Task Checklist: Part 2, Protocol 2c

Use this checklist to make sure that you have completed all of the tasks in the protocol.

Everyone should...

- ❑ Read all of the steps in the procedure and take on the various roles.
- ❑ Gather the materials needed to complete the protocol.

The Facilitator should...

- ❑ Help everyone to complete their tasks and keep them focused on the tasks.
- ❑ Make sure that all of the data is gathered and legibly recorded.

The Snake and Salamander Technicians should...

- ❑ Set out the sampling boards (first year only).
- ❑ Check the sampling boards at the ends of each transect.
- ❑ Identify and record the number and species.

The Spider Technicians should...

- ❑ Count spider webs in a 2m wide path, 7.5 m to the right of the transect line between the 0 and 10 m points and then repeat to the left of the line..
- ❑ Repeat these counts for each 10 m segment of the transect.
- ❑ Sample spider abundance at the 100, 80, 60, 40, 20, and 0 m points with an umbrella.

After completing the protocol, everyone should...

- ❑ Prepare the data for submission to the ForestWatch Coordinator

Data Sheet: Part 2, Protocol 2c

Date	

Name	Role
1.	
2.	
3.	
4.	
5.	

Site Location	
County:	
Township Name:	
Township (ex. T12S):	
Range (ex. R4W):	
Section Number:	
Transect Letter	

Snakes and Salamanders Data Sheet: Part 2, Protocol 2c

Weather & Temperature: Circle the appropriate descriptor.

Cloud Cover	Precipitation	Temperature
sunny intermittent sun hazy cloudy	dry humid raining	below 50° F 50-60° 60-70° 70-80° 80-90° over 90° F

Record the numbers and species of salamanders and snakes found beneath each board. The board should be described by the letter of the nearest transect and the nearest meter mark, e.g. Transect B, 100 m.

Board	Species	Number
B -- 100 m	Brown Snake	1

Spider Data Sheet I: Part 2, Protocol 2c

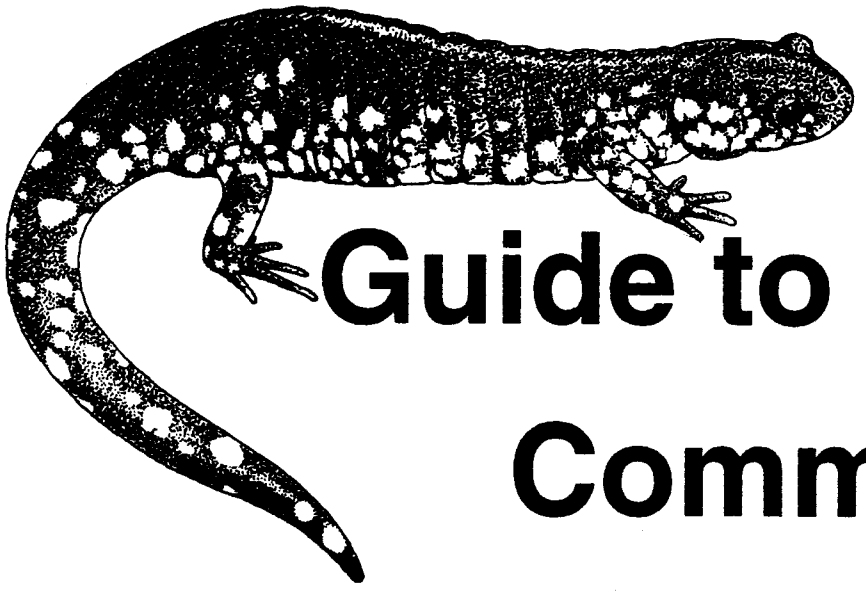
Record the number of spider webs in a 2m wide path, 7.5 m to the right and left of the transect line for each 10 m segment of the transect.

	Number of Orb Spider Webs	
Transect Segment	Left Side	Right Side
1 - 10 m		
10 - 20 m		
20 - 30 m		
30 - 40 m		
40 - 50 m		
50 - 60 m		
60 - 70 m		
70 - 80 m		
80 - 90 m		
90 - 100 m		

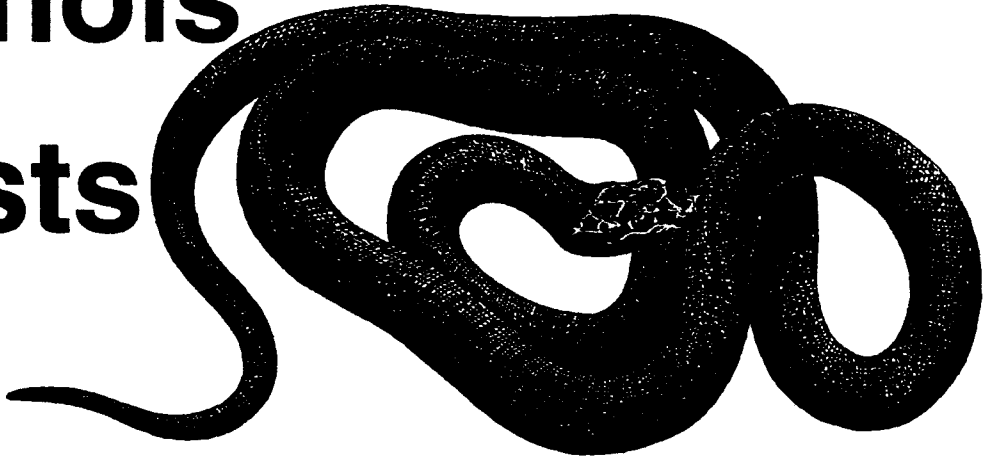
Spider Data Sheet II: Part 2, Protocol 2c

Record the number of spiders and the number of types of spiders you find in the umbrella at each point.

	Number	
Sampling Point	Total Spiders	Types of Spiders
100 m		
80 m		
60 m		
40 m		
20 m		
0 m		

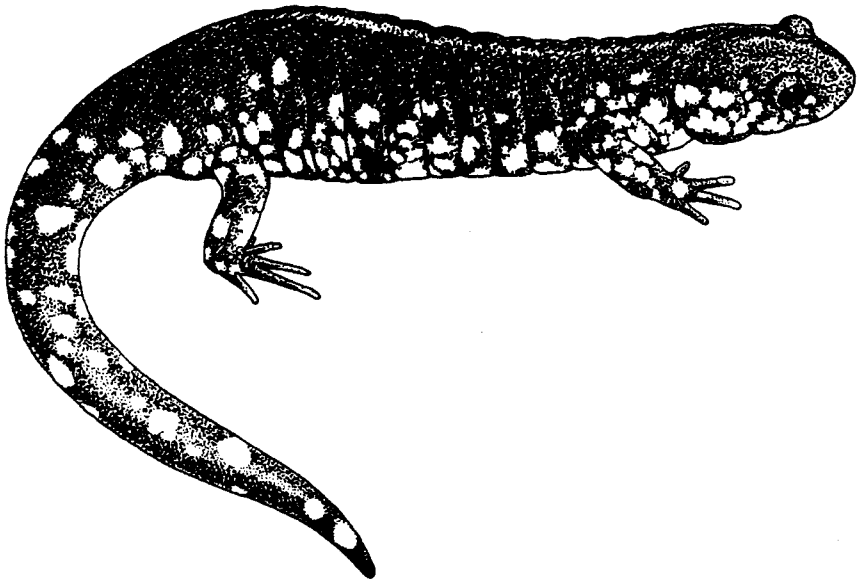


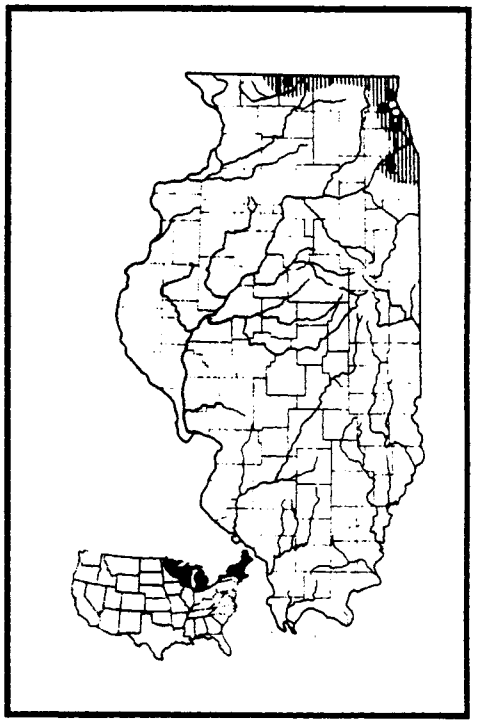
Guide to the Common Snakes and Salamanders of Illinois Forests



Blue-spotted Salamander (*Ambystoma laterale*)

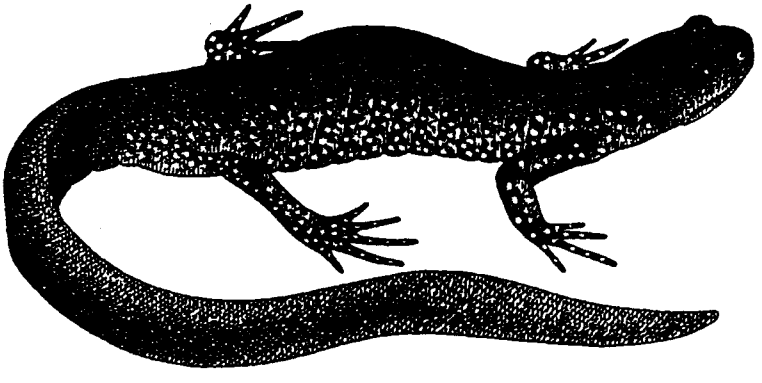
This small salamander (130 mm in length) has a back that is black to bluish and a dark underside. It often has intense white or bluish flecking covering both the sides and undersides.

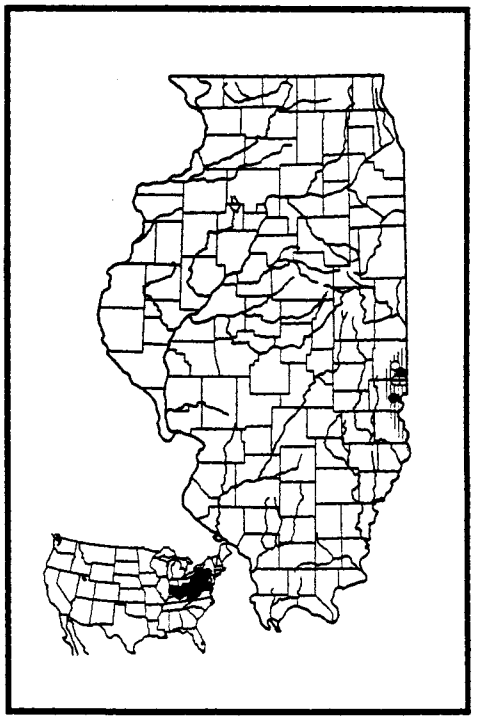




Jefferson Salamander (*Ambystoma jeffersonianum*)

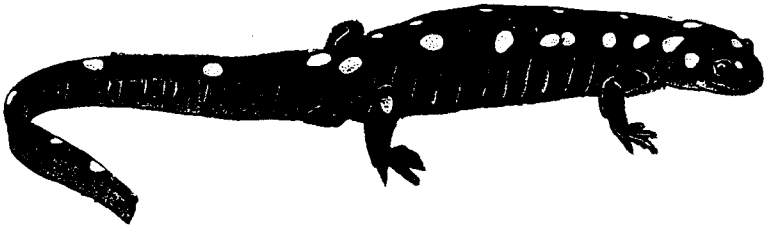
This salamander ranges to 210 mm in length. It is brown to gray with a distinctly paler underside. It has bluish flecking that is usually confined to the limbs and lower sides.

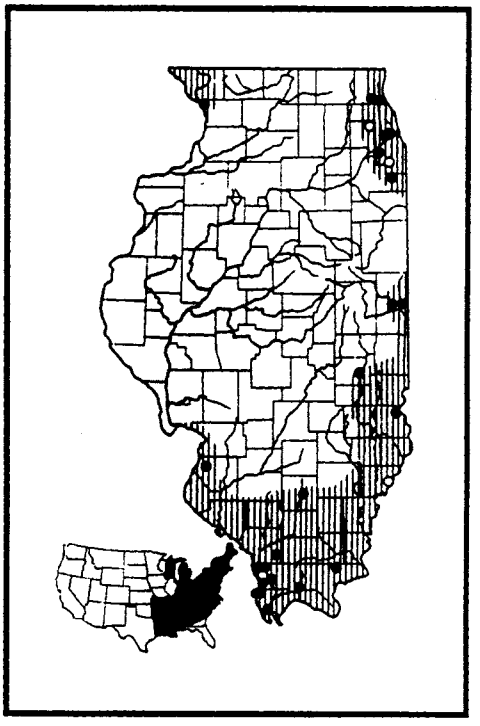




Spotted Salamander (*Ambystoma maculatum*)

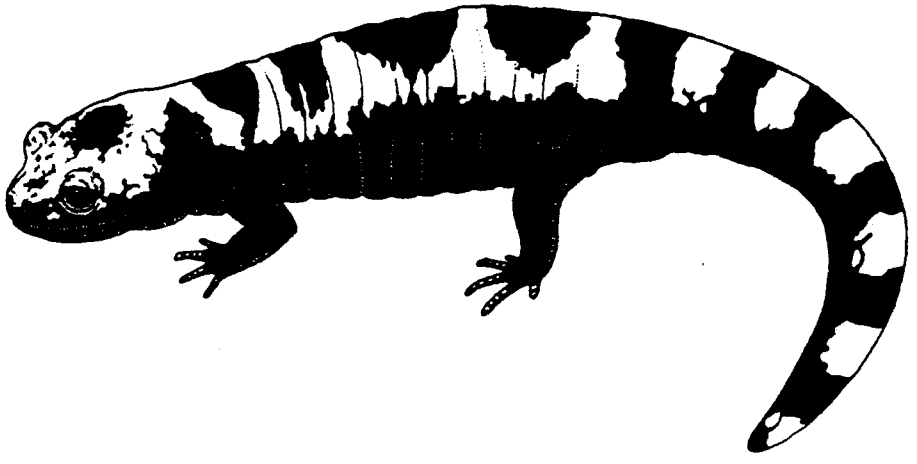
This salamander reaches a length of 200 mm. It is black above, pale gray below, and has a row of bright yellow or orange spots from snout to tail on each side of the body.

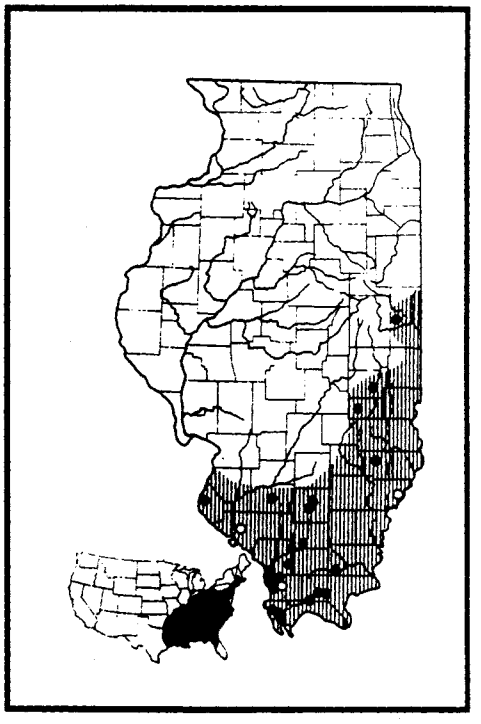




Marbled Salamander (*Ambystoma opacum*)

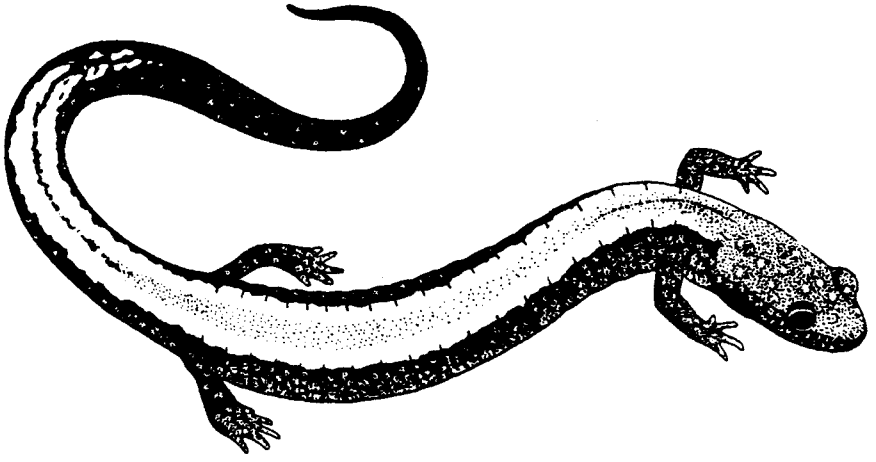
This medium-sized and stout salamander is black with 3 to 8 silvery to grayish-white crossbands on the back and 4 to 8 white rings around the tail.

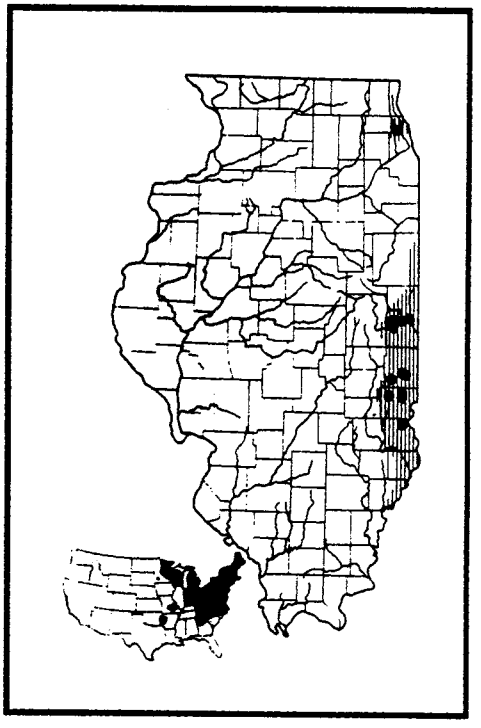




Red-backed Salamander (*Plethodon cinereus*)

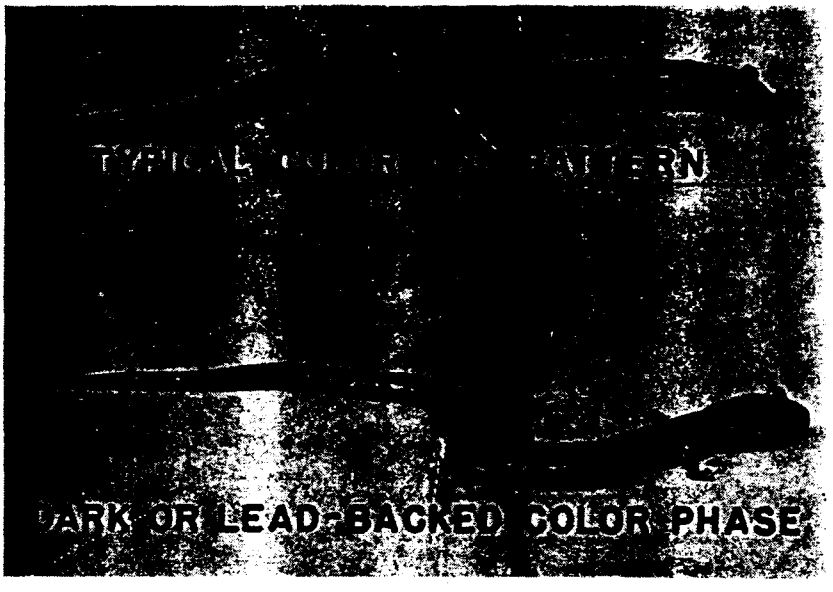
This small salamander (up to 109 mm in length) comes in two versions: the lead-backed phase which is uniformly black or brown above, and the red-backed phase which is dark with a broad red stripe from snout to tail. The undersides of both are mottled dark and white.

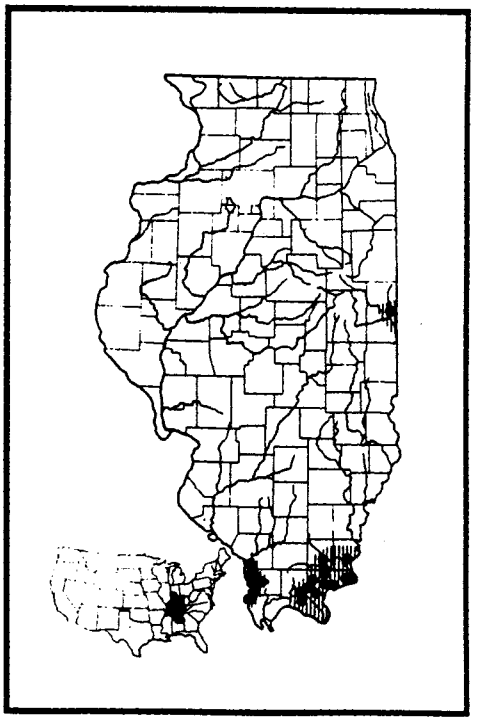




Zig Zag Salamander (*Plethodon dorsalis*)

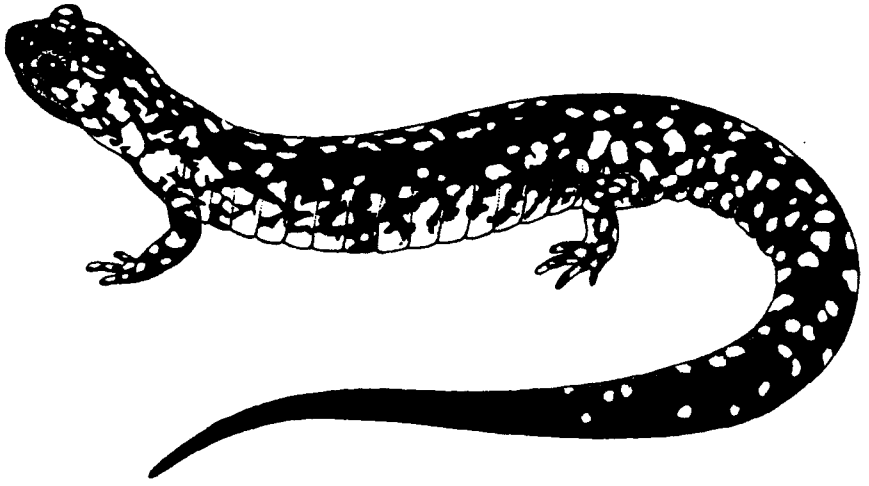
This is a small (up to 110 mm in length), slender, red-backed or uniformly dark salamander. It has a red or yellow stripe that zig zags down its back. The red-backed Salamander's stripe is straight-edged.

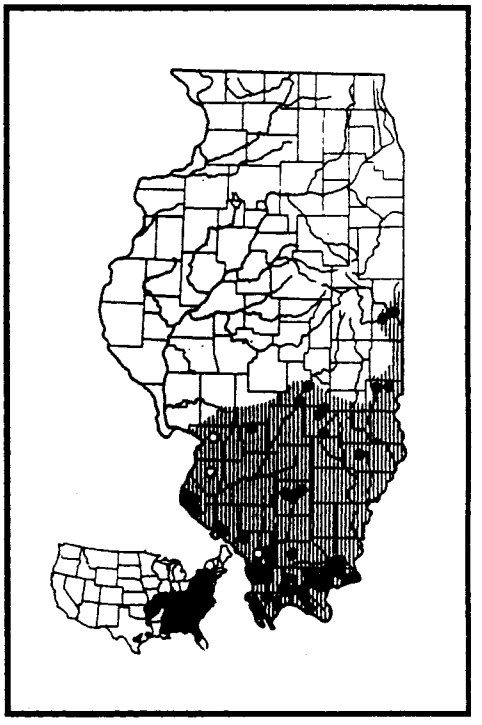




Slimy Salamander (*Plethodon glutinosus*)

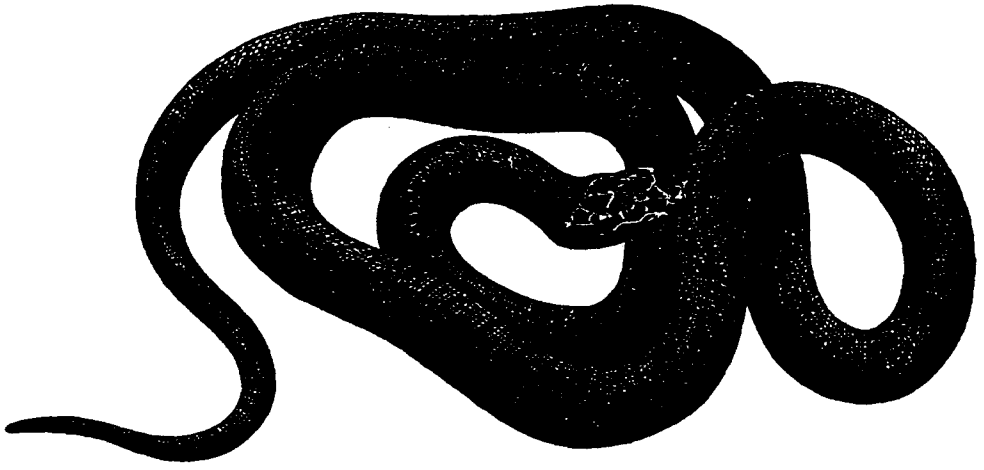
This medium-sized salamander (up to 167 mm in length) has a black to bluish-black back with white flecks, white or silvery-white sides, and a uniformly black (with occasional flecks) underside. They are so quick and slimy that they are hard to pick up.

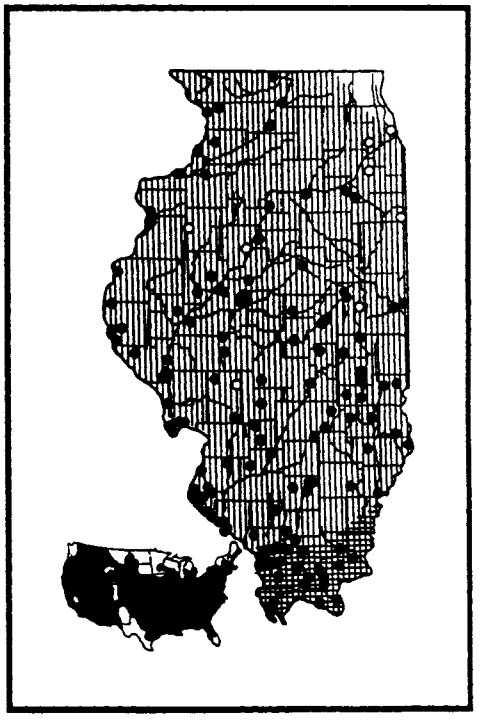




Blue Racer (*Coluber constrictor*)

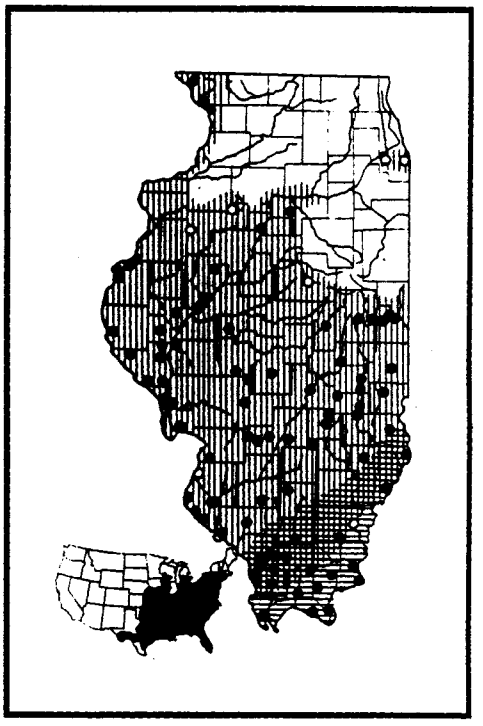
This slender, large snake (up to 1.5 m in length) is blue-green, blue-black, or black. Its underside is yellowish-white to dark-slate. The hatchlings have red-brown blotches on their back.





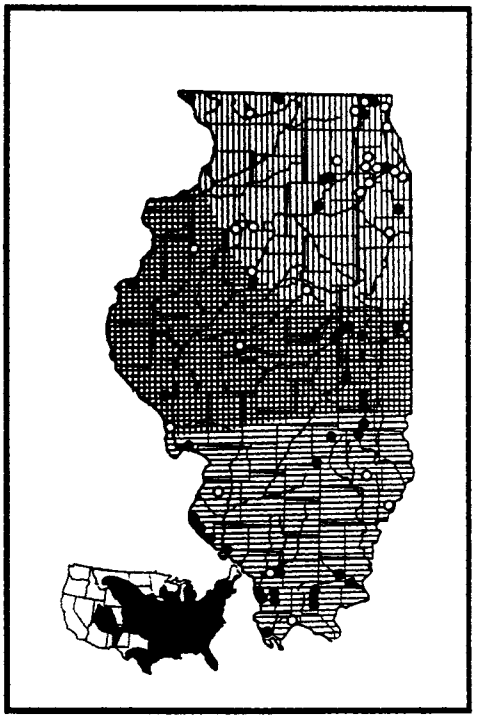
Black Rat Snake (*Elaphe obsoleta*)

This large, stout-bodied snake (up to 1.7 m in length) has a mostly black back with milky white areas showing between scales. Its underside is yellowish-white, and checkered and stippled with black. The subspecies found in southern Illinois has dark blotches on a gray background as do the hatchlings of both subspecies.



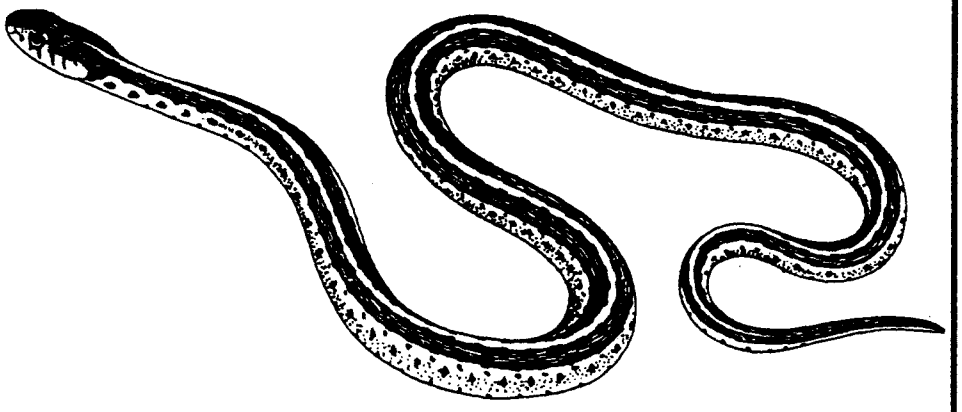
Milksnake (*Lampropeltis triangulum*)

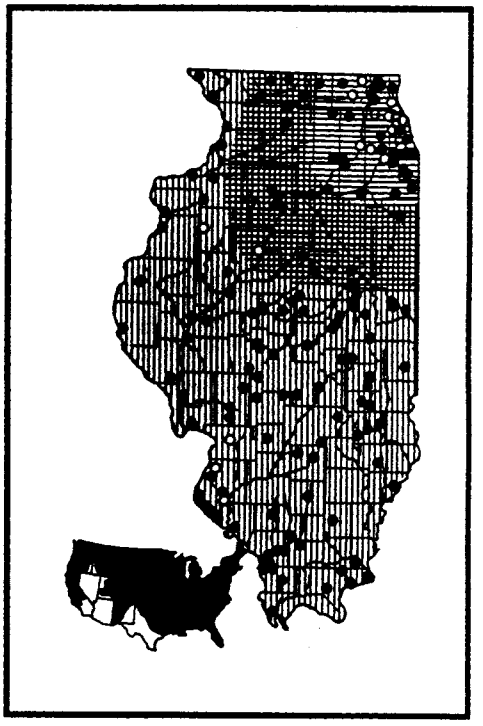
This slender, medium-sized (up to 1.1 m in length) snake is gray or white and is covered with black-margined, brown blotches on its back. The subspecies found in southern Illinois has red or scarlet blotches instead of brown ones. The blotch on the back of the neck is 'Y' or 'V' shaped. They feed on mammals, lizards, and other snakes. Farmers once thought that the snakes stole milk from cows because they were often seen hunting around barns.



Common Garter Snake (*Thamnophis sirtalis*)

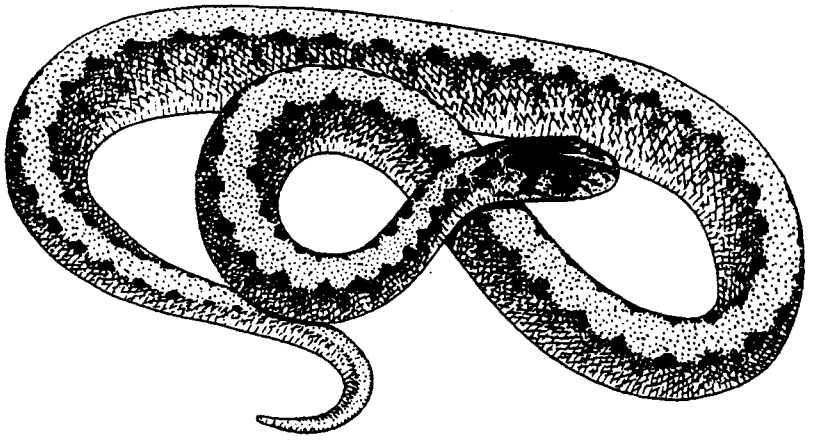
This moderately sized (up to 1 m in length), slender snake is brown, red-brown, or dark blue-green. It has a stripe down its back that is gray or yellow and similarly-colored stripes on its sides. Its underside is gray-green.

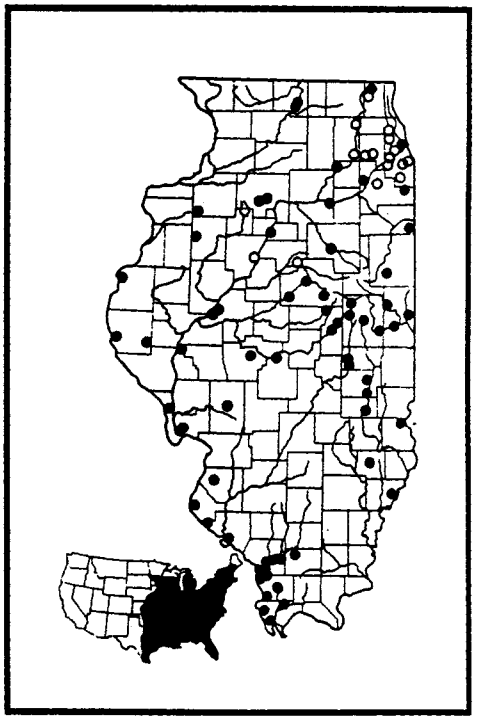




Brown Snake (*Storeria dekayi*)

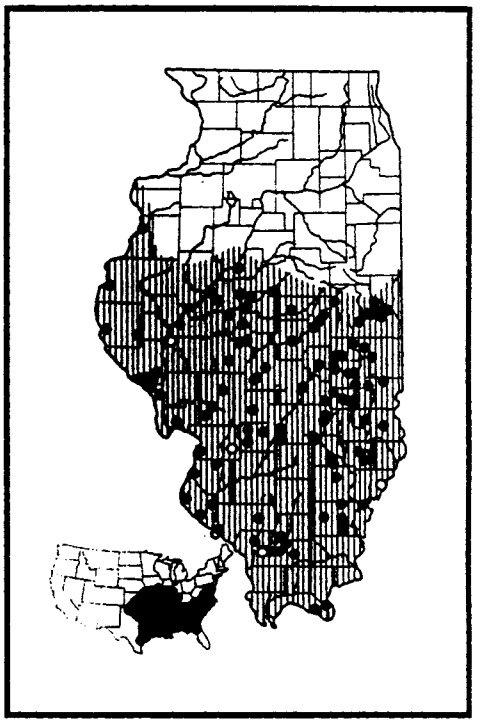
This small (up to 0.4 m in length) moderately stout snake is gray or light brown. It has two rows of dark spots down its back and these may be connected across the back with dark bars. The back, between the rows of spots, is lighter, giving it the appearance of a wide stripe. It has dark blotches on both sides of its neck right behind its head. Its underside is light.





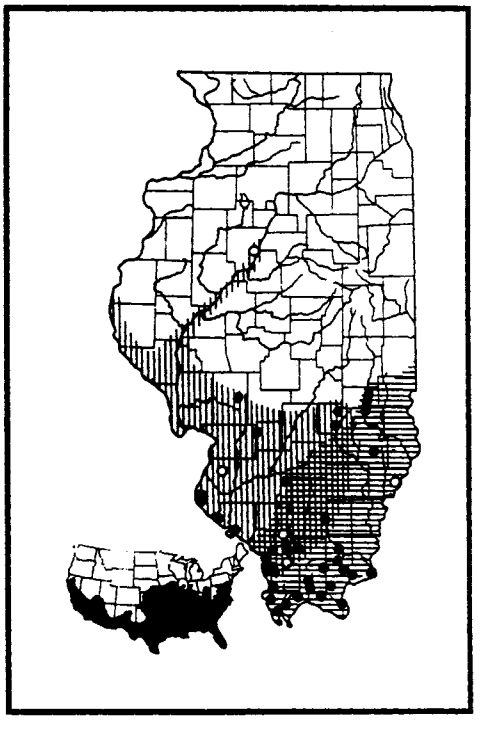
Prairie Kingsnake (*Lampropeltis calligaster*)

This large (up to 1.3m in length) moderately slender snake is gray, brown, or straw-colored with 41 to 64 dark blotches on its back with a series of dark spots on each side that alternate with the blotches. It's underside is gray-white or yellowish-gray.



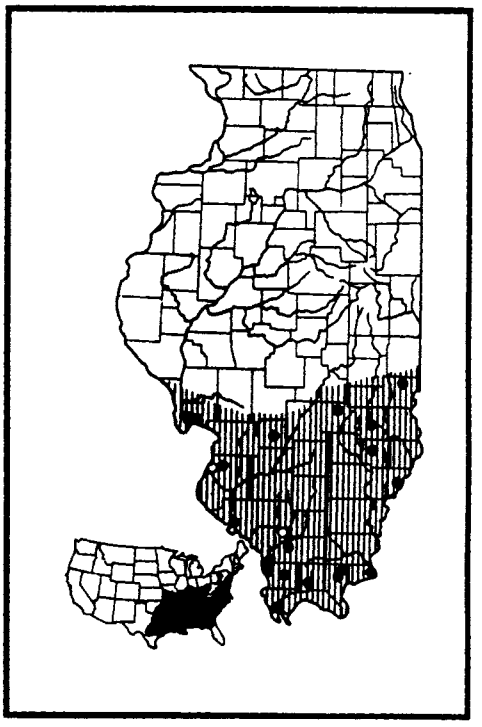
Speckled Kingsnake (*Lampropeltis getulus*)

This large (up to 1.2 m in length), moderately slender snake is black with each scale containing a yellow spot. Sometimes the spots are arranged to form faint crossbands. Its underside is checkered with more black than yellow.



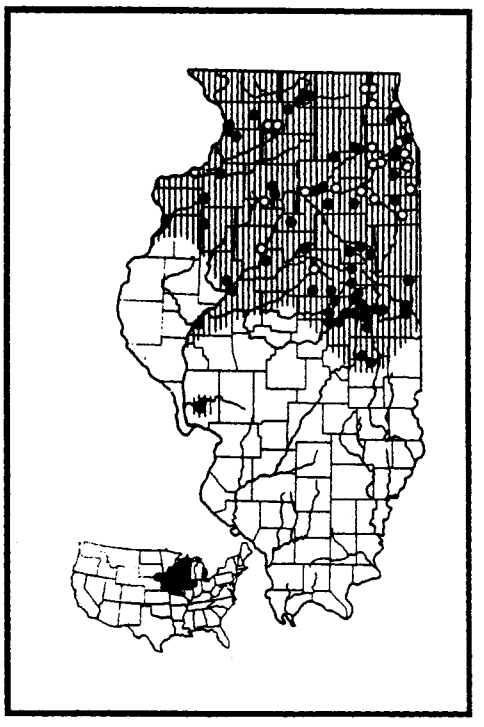
Earth Snake (*Virginia valeriae*)

This small (less than 0.3 m in length), stout-bodied snake is olive, medium brown, or gray-brown and sometimes has small dark flecks on its back. Its underside is white, sometimes with a few dark flecks.



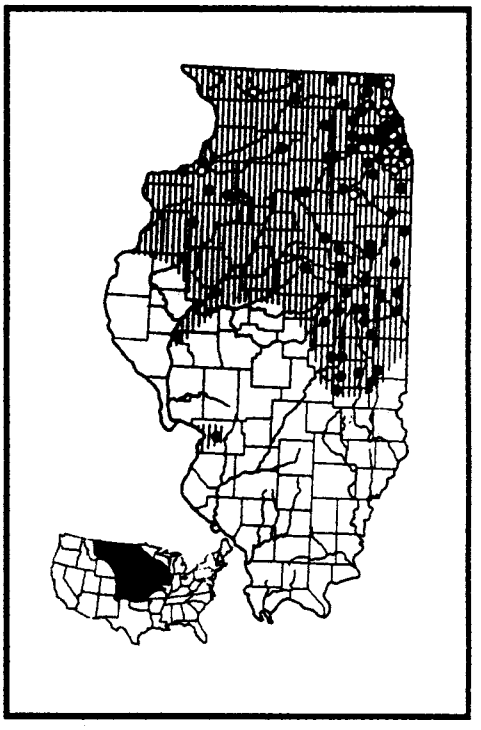
Fox Snake (*Elaphe vulpina*)

This large (up to 1.2 m in length) moderately stout-bodied snake is yellow-gray and covered with 34 to 42 red-brown spots on its back. It has an alternating row of brown spots on each side of its body. Its head is coppery colored. Its underside is yellow and boldly marked with black.



Great Plains Garter Snake (*Thamnophis radix*)

This medium-sized (up to 0.7 m in length), moderately slender snake is brown with three stripes. The stripe running down the middle of its back is orange-yellow and the stripes on the sides are yellow-gray and narrower. There is a checkerboard pattern between the top and side stripes. Its underside is gray-green and may have dark spots as well.



Title: Part 2, Protocol 2d -- Evaluating forest and tree health.

Question: Do trees show symptoms of stress related to pollution, ozone damage, defoliating insects, or natural disturbance. Are these symptoms changing over time?

Goal: To determine the health of trees in the canopy and subcanopy by estimating the density of leaves and branches in tree crowns, and evaluating the condition of tree trunks.

Purpose: An early sign of stress in forests is the thinning of tree crowns -- the portions of trees that contain most of the branches and leaves. Another is changes in the conditions of tree trunks. Acid rain, ozone depletion, and global warming are all factors that can increase stress in trees. This exercise is designed to serve as an early warning detection device for the effects of atmospheric pollution and global change. There are, however, other factors that cause stress in trees, such as insect outbreaks and storm damage. We want to track signs of stress in individual trees to see if, and when, they appear over large regions of Illinois.

One example of where this sort of monitoring could have helped is in preventing the spread of Dutch Elm disease. Dutch Elm disease is caused by a fungus and is spread by beetles. It has killed most of the elm trees in the northeastern United States since it was brought into the country in the first half of this century. We could have detected the introduction and spread of Dutch Elm disease earlier if we had been monitoring for signs of stress in trees instead of waiting until we saw the widespread mortality of elms. Once the disease was identified, the spread of it was slowed by the immediate removal of diseased trees. Numerous other tree diseases and insect pests have the potential to invade Illinois including Dogwood anthracnose, Oak wilt, and Gypsy moths.

Strategies for managing the spread of these diseases and pests can be developed when signs of stress are identified early By monitoring the forests for these signs, we hope to detect new outbreaks of plant diseases or pests before they become widespread. Likewise, it is important to determine if there are signs of pollution stress on Illinois trees. As of 1994, Illinois forests displayed relatively few signs of pollution stress.

Materials:

110 m long rope knotted at 10 m intervals (or 100 m measuring tape)

For Canopy Trees --

- Genus Identification Cards from Part 2, Protocol 1
- Taxonomist's Key from Part 2, Protocol 1
- Crown Density Worksheets 1 and 2
- 2 Foliage Transparency Reference Cards
- Crown Ratio Reference Card
- Trunk Condition Reference Card
- Tree Height Reference Card
- Calculator
- Canopy Data Sheet
- Meter stick
- Clipboard
- Pencil

For Sapling Trees --

- Genus Identification Cards from Part 2, Protocol 1

Taxonomist's Key from Part 2, Protocol 1
Vigor Class Reference Card
Crown Ratio Reference Card
Sapling Data Sheet
Meter Stick
Clipboard
Pencil

Procedure:

1. Read all of the steps in the procedure and assign members in your group the following roles. If you don't have five people in your group, you may take on more than one role. Alternatively, your teacher may wish to assign you to a specific role or two. The roles are:

Facilitator -- One person who makes sure that the group quickly and accurately completes the protocol by having individuals fulfill their particular tasks. Also makes sure that all of the data sheets are filled out legibly and completely.

Canopy Technicians -- Two people who identify the genus and then estimate crown density, foliage transparency, crown ratio, and trunk condition of the trees in the overstory. They record the results on the Canopy Data Sheet.

Sapling Technicians -- Two people who identify the genus and then estimate vigor class and crown ratio of trees in the understory. They then record the results on the Sapling Data Sheet.

2. Gather the materials listed above for your group. Locate your transect and run a rope that is knotted every 10 m between the stakes that mark its beginning and end. (You may have already done this. If not, refer to Part 2, Protocol 1 for instructions.) Alternatively, you may use a 100 m measuring tape.

3. The Canopy Technicians are responsible for characterizing the health of the tallest trees in the forest, those that reach up into the canopy. If you are a canopy technician, your duties include characterizing the tree height, estimating the crown density, estimating the foliage transparency, determining the crown ratio, and recording the trunk condition of five trees along the transect.

To select the first tree to characterize, stand at the 10 m point along your transect and face into the forest. From this point, locate the first tree that meets the following criteria:

A. It must be within 7.5 m of either side of the transect.
B. The same type of tree must occur at least three times in the canopy of the forest in the 20 m section of the transect between the 0 m and 20 m marks.
C. It must be in the largest size class of trees for that section of transect. This means that the tree should reach into, and form part of, the canopy. (Refer to your data from Part 2, Protocol 1 to see which is the largest size tree class for that specific section of your transect.)

Determine the genus of the tree --

Use the Taxonomist's Key and genus identification cards from Part 2, Protocol 1 to determine the tree's genus. Record your answer.

Characterize the height of the tree --

Refer to the Tree Height Reference Card. Record the code that best describes the height the tree reaches relative to other trees in the forest.

Determine the crown density --

This measures the percentage of the crown of the tree that blocks light from coming through it. To measure this, you and your partner should stand on opposite sides of the tree, about a tree length away. You then outline the crown of the tree on the Crown Density Worksheet. Next, draw in the gaps of the crown where vegetation is missing and light is coming through. Finally, compare the full outline of the crown to the portion that is blocking sunlight.

To do this, you count the number of dots within the outline of the entire crown. Next count the number of dots within the crown outline that are in portions that are blocking sunlight. To get a proportion of the crown that is blocking sunlight, you divide the number of dots blocking sunlight (the smaller number) by the total number of dots in the crown outline (the larger number) and multiply by 100.

For example, the tree in Figure 1a has an outline as shown in 1b, with gaps as shown in 1c. You can count 125 dots within the outline of the crown in 1b and 112 dots in the portion of the crown that blocks sunlight as shown in 1c. Consequently the percentage of the crown that blocks sunlight is...

$$[112 \div 125] \times 100 = 89.6\ \%$$

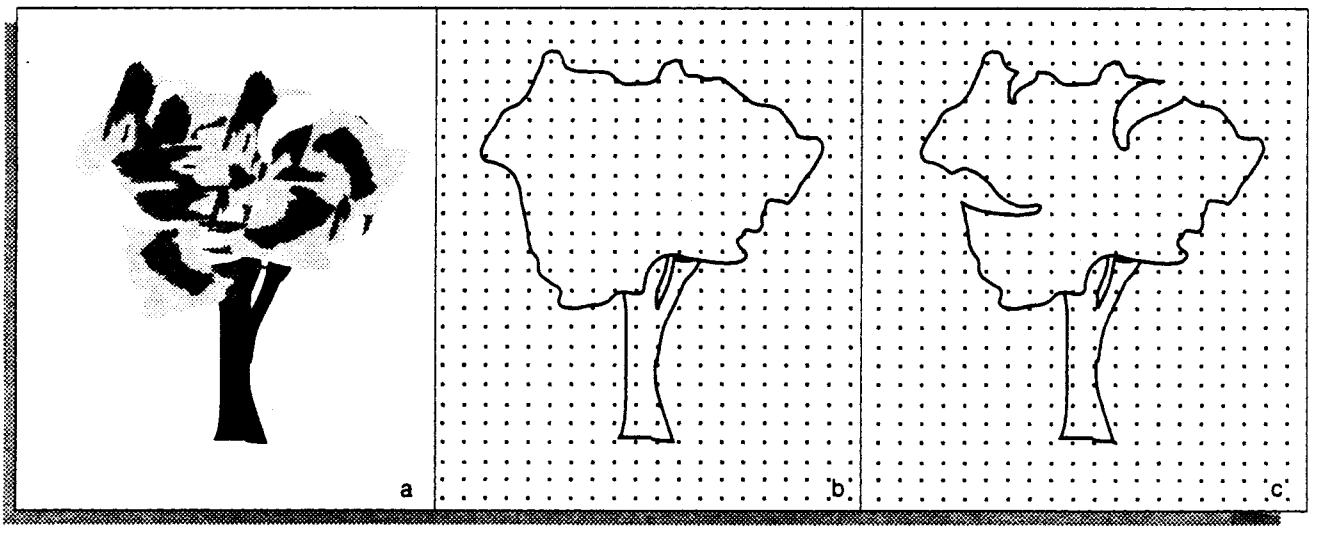


Figure 1. Estimate the density of the crown of a tree by sketching its outline over a grid, drawing in the gaps of the crown, and then comparing the number of dots within the total outline of the crown to the number when the gaps have been added.

Repeat this procedure from a vantage point 90° from the first so that you and your partner estimate crown density on all four sides of the tree. Average your four estimates, round to the nearest 10 percent, and record your answer.

Determine foliage transparency --

Foliage transparency is a measure of the amount of light that is filtering through the leaves in the crown of the tree. You and your partner should stand on opposite sides of the tree with your backs against the trunk. Look up at the crown and compare the amount of light filtering through the leaves to the Foliage Transparency Card held at arm's length. Repeat this from a position 90° to the first position so that you and your partner have estimates for all four sides of the tree. Average your four estimates, round the average to the nearest 10 percent, and record your answer. Take a look at Figure 2.

Figure 2. Estimate the foliage transparency by standing with your back to the tree's trunk, looking up at the crown, and comparing the amount of light coming through the crown to the foliage transparency card.

Estimate the crown ratio --

The crown ratio is the percentage of the height of the tree that supports live foliage. You and your partner should stand at opposite sides of the tree, about a tree length away. You then visually estimate the length of the tree covered by its crown (the crown length) relative to the total length of the tree with the help of the Crown Ratio Reference Card.

The crown is defined as the continuous portion of the trunk where side branches extend out. For most trees this is relatively discrete and visible. If there are individual branches below the base of the crown, include them in the measure of the crown length only if they have a diameter where they meet the trunk greater than 3 cm, and are within 2 m of the crown base.

If you have trouble estimating the height of the tree or the length of the crown, have someone stand next to the tree and use them to help you estimate. If the person is 5 feet tall and the tree is 3 times their height, then you should estimate that the tree is 15 feet tall. If the crown of the tree is only one and a half times as tall as they are, then you estimate that the crown is 7.5 feet in length.

Repeat this from a position 90° to the first so that you and your partner have estimates for all four sides of the tree. Average your four estimates, round the average to the nearest 10 percent, and record your answer.

Evaluate the condition of the trunk --

Compare the trunk to the categories on the Trunk Condition Reference Card. Pick one of the categories and record your answer.

Repeat this procedure (Step 3) at the 30, 50, 70, and 90 m marks along the transect!

4. The Sapling Technicians are responsible for characterizing the health and condition of tree saplings (trees that are between 5 and 12.5 cm in diameter) . If you are a sapling technician, your duties include identifying to genus, evaluating vigor, and estimating crown ratio of three saplings in every 20 m segment of the transect.

To select the first three saplings to characterize, stand at the 0 m point of your transect and face into the forest. From this point, locate three saplings of the same type that occur at least five times in the 15 m wide path (7.5 m to either side of the transect) up to the 20 m mark. The saplings should be as far apart from one another as possible in the 15 m x 20 m plot.

Identify the saplings to genus --

Use the Taxonomist's Key and genus characteristics cards from Part 2, Protocol 1 to determine the genus of the saplings. Record your answer.

Evaluate the vigor class of each sapling --

Use the Vigor Class Reference Card to categorize the condition of each sapling. Record your answers.

Estimate the crown ratio of each sapling --

> The crown ratio is the percentage of the height of the sapling that supports live foliage. You and your partner should stand at opposite sides of the sapling, about a tree length away. You then visually estimate the length of the tree covered by its crown (the crown length) relative to the total length of the tree with the help of the Crown Ratio Reference Card.
>
> If you have trouble estimating the height of the tree or the length of the crown, have someone stand next to the tree and use them to help you estimate. If the person is 5 feet tall and the tree is 3 times their height, then you should estimate that the tree is 15 feet tall. If the crown of the tree is only one and a half times as tall as they are, then you estimate that the crown is 7.5 feet in length.
>
> Repeat this from a position 90° to the first so that you and your partner have estimates for all four sides of the sapling. Average your four estimates, round the average to the nearest 10 percent, and record your answer.

Repeat this procedure (Step 4) at the 20, 40, 60, and 80 m points along the transect! Try to use different species at each 20 m segment.

5. If you have enough time, repeat these procedures on another transect. Ask your teacher which transect would be most useful for you to work on next.

6. Turn in the tools and data sheet. Congratulations, you are done with this protocol! Plan on preparing your data for submission to the Illinois ForestWatch coordinator.

Task Checklist: Part 2, Protocol 2d

Use this checklist to make sure that you have completed all of the tasks in the protocol.

Everyone should...

- ❑ Read all of the steps in the procedure and take on the various roles.
- ❑ Gather the materials needed to complete the protocol.

The Facilitator should...

- ❑ Help everyone to complete their tasks and keep them focused on the tasks.
- ❑ Make sure that all of the data is gathered and legibly recorded.

The Canopy Technicians should...

- ❑ Select the first tree to characterize at the 10 m point.
- ❑ Determine the genus of the tree.
- ❑ Characterize the height of the tree.
- ❑ Determine the crown density.
- ❑ Determine foliage transparency.
- ❑ Estimate the crown ratio.
- ❑ Evaluate the condition of the trunk.
- ❑ Repeat these steps at the 30, 50, 70, and 90 m marks along the transect.

The Sapling Techinicians should...

- ❑ Select the first three saplings to characterize.
- ❑ Identify the saplings to genus.
- ❑ Evaluate the vigor class of each sapling.
- ❑ Estimate the crown ratio of each sapling.
- ❑ Repeat these steps at the 20, 40, 60, and 80 m points along the transect.

After completing the protocol, everyone should...

- ❑ Prepare the data for submission to the ForestWatch Coordinator.

Data Sheet: Part 2, Protocol 2d

Date	

Name	Role
1.	
2.	
3.	
4.	
5.	

Site Location	
County:	
Township Name:	
Township (ex. T12S):	
Range (ex. R4W):	
Section Number:	
Transect Letter	

Canopy Data Sheet: Canopy Part 2, Protocol 2d

Circle your choice for Genus, Tree Height and Trunk Condition. Enter the percentages for Crown Density, Foliage Transparency and Crown Ratio.

Genus	Tree Height	Crown Density	Foliage Trans.	Crown Ratio	Trunk Condition
10 m Sampling Point					
Maple Oak Hickory Ash Pine Beech Walnut Elm Other	Overgrown Dominant Codominant Intermediate Overtopped Other				Straight Trunk Broken Trunk Twisted Stem Unusual Growth Stem Scars Other
30 m Sampling Point					
Maple Oak Hickory Ash Pine Beech Walnut Elm Other	Overgrown Dominant Codominant Intermediate Overtopped Other				Straight Trunk Broken Trunk Twisted Stem Unusual Growth Stem Scars Other
50 m Sampling Point					
Maple Oak Hickory Ash Pine Beech Walnut Elm Other	Overgrown Dominant Codominant Intermediate Overtopped Other				Straight Trunk Broken Trunk Twisted Stem Unusual Growth Stem Scars Other
70 m Sampling Point					
Maple Oak Hickory Ash Pine Beech Walnut Elm Other	Overgrown Dominant Codominant Intermediate Overtopped Other				Straight Trunk Broken Trunk Twisted Stem Unusual Growth Stem Scars Other
90 m Sampling Point					
Maple Oak Hickory Ash Pine Beech Walnut Elm Other	Overgrown Dominant Codominant Intermediate Overtopped Other				Straight Trunk Broken Trunk Twisted Stem Unusual Growth Stem Scars Other

Sapling Data Sheet: Sapling Part 2, Protocol 2d

Record the genus of the sapling. Circle its vigor class. Calculate and record its crown ratio.

0 m Sampling Point		
Genus	Vigor Class	Crown Ratio
1.	1, 2, 3, or 4	
2.	1, 2, 3, or 4	
3.	1, 2, 3, or 4	

20 m Sampling Point		
Genus	Vigor Class	Crown Ratio
1.	1, 2, 3, or 4	
2.	1, 2, 3, or 4	
3.	1, 2, 3, or 4	

40 m Sampling Point		
Genus	Vigor Class	Crown Ratio
1.	1, 2, 3, or 4	
2.	1, 2, 3, or 4	
3.	1, 2, 3, or 4	

60 m Sampling Point		
Genus	Vigor Class	Crown Ratio
1.	1, 2, 3, or 4	
2.	1, 2, 3, or 4	
3.	1, 2, 3, or 4	

80 m Sampling Point		
Genus	Vigor Class	Crown Ratio
1.	1, 2, 3, or 4	
2.	1, 2, 3, or 4	
3.	1, 2, 3, or 4	

Tree Height Reference Card: Canopy Part 2, Protocol 2d

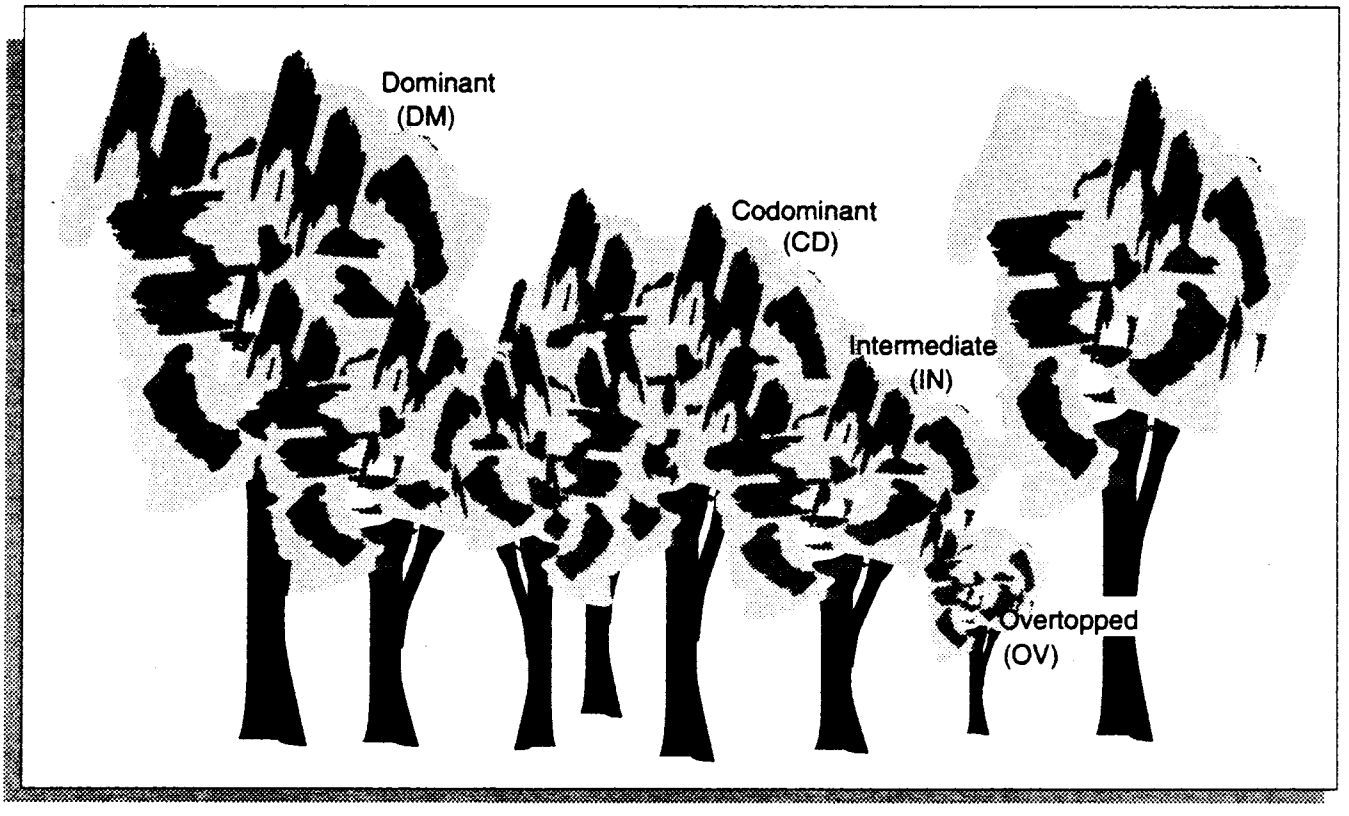
OG -- Open Grown. The tree clearly rises above the surrounding vegetation, usually characterized by large and robust branches. It usually stands apart from other trees of its size, for example, a tree in a field.

DM --Dominant. The tree reaches the uppermost layer of the forest canopy.

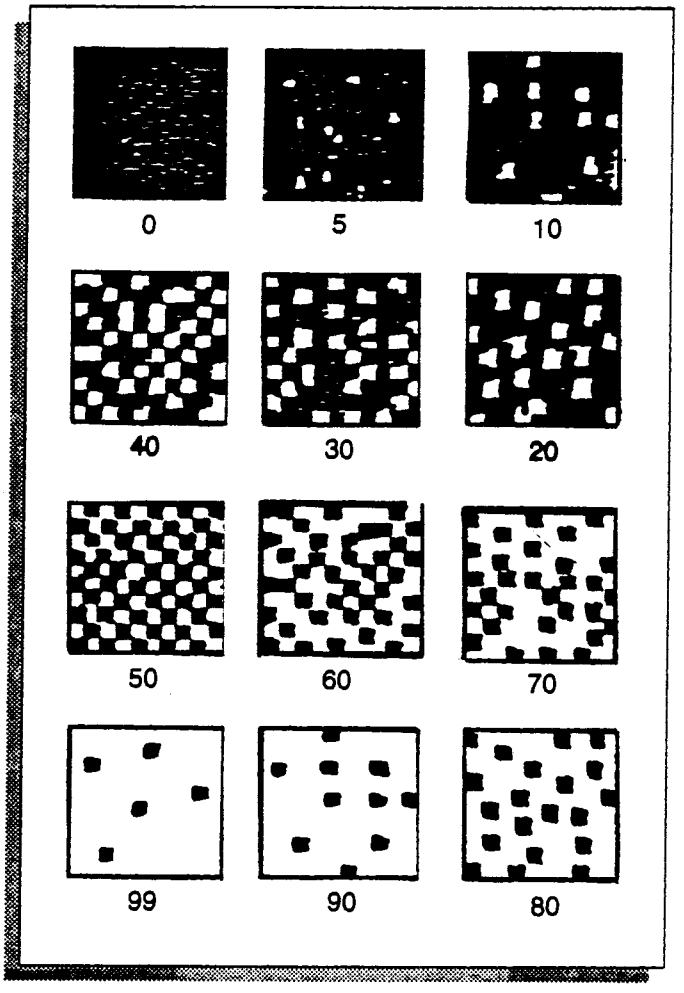
CO -- Codominant. The crown of the tree is within the uppermost layer of the forest canopy.

IN -- Intermediate. The crown is lower than the dominant layer of canopy vegetation, but extends into the codominants.

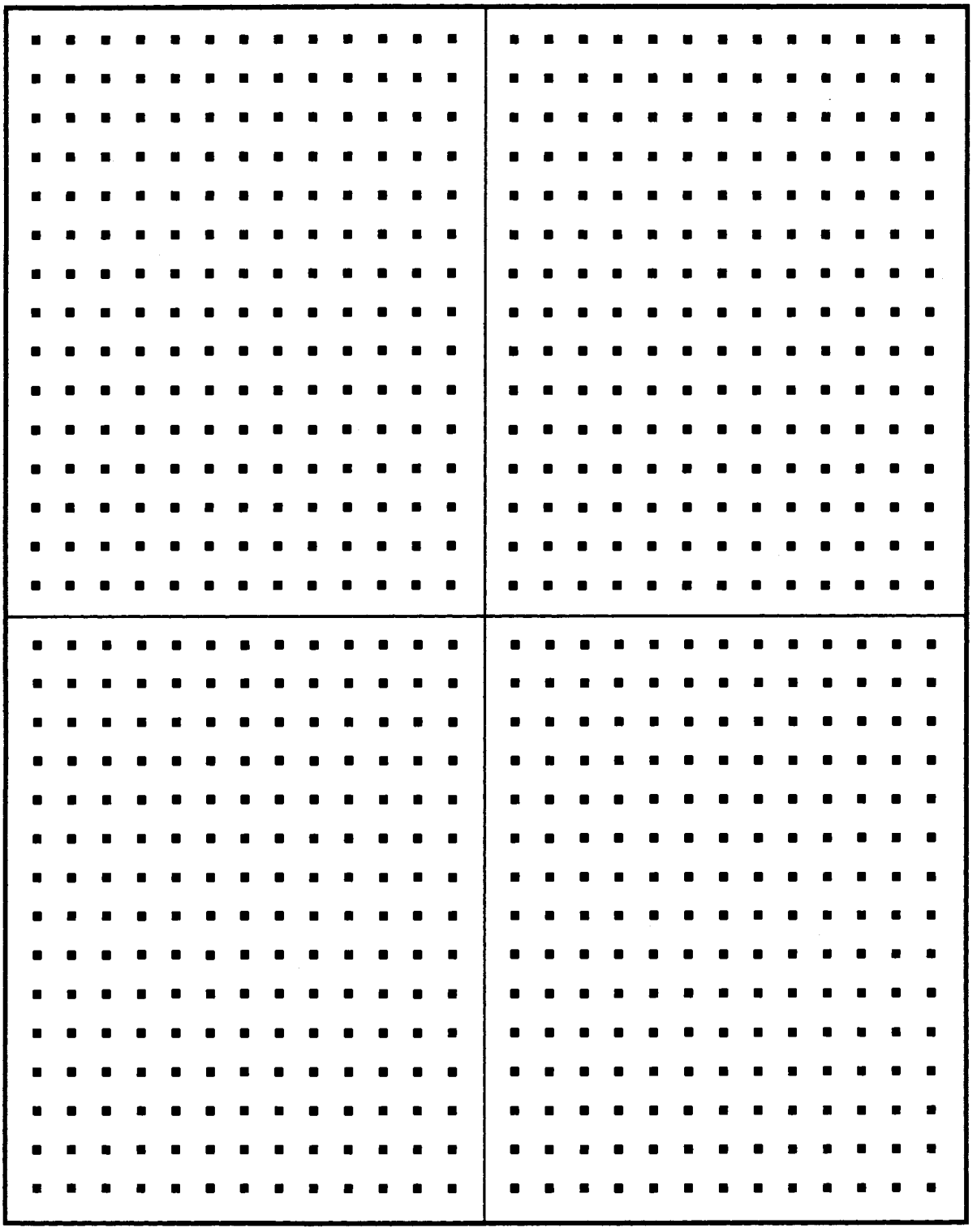
OV -- Overtopped. The crown of the tree is clearly below the layer of codominants.



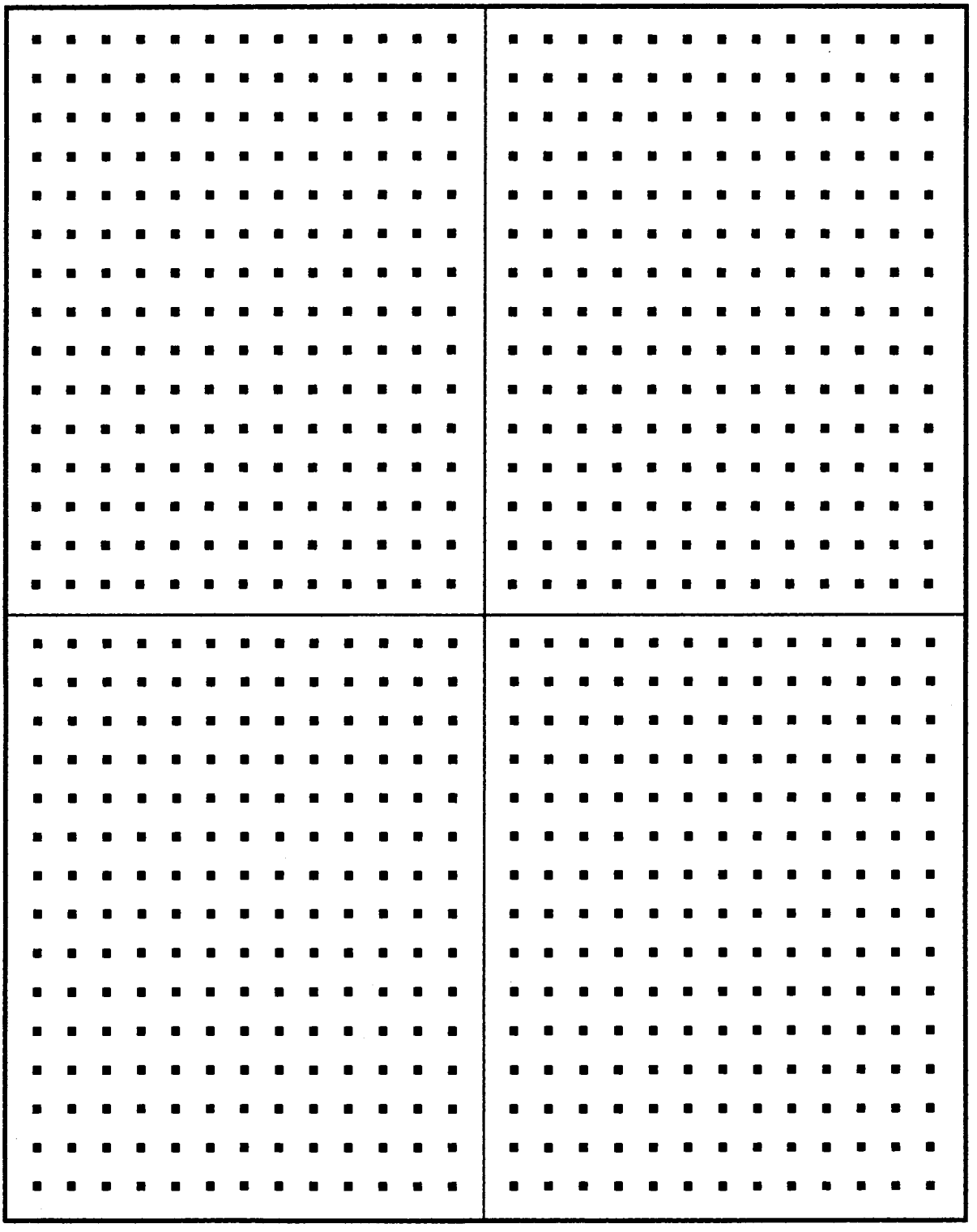
Foliage Transparency Reference Card: Canopy Part 2, Protocol 2d



Crown Density Worksheet 1: Canopy Part 2, Protocol 2d



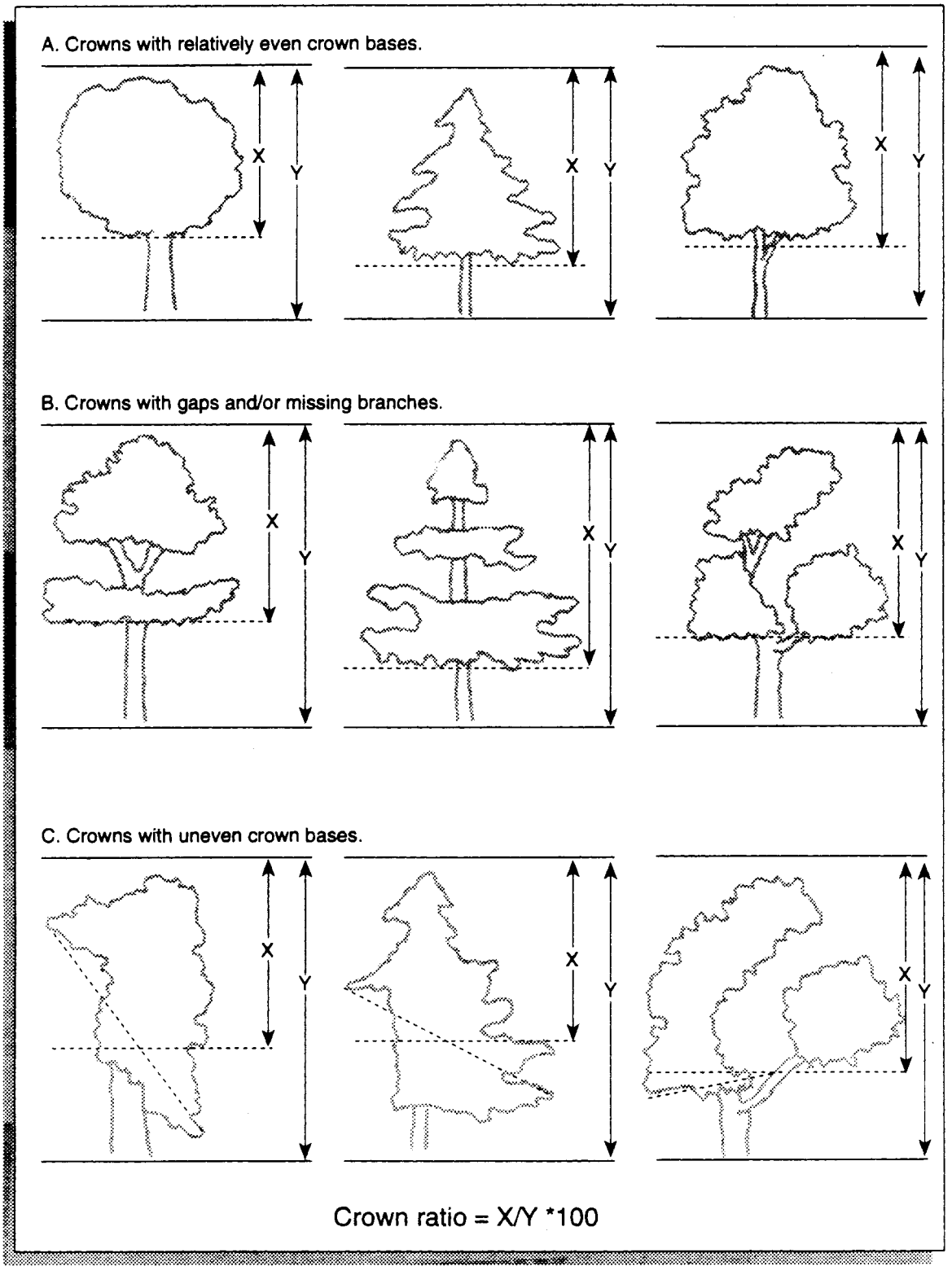
Crown Density Worksheet 2: Canopy Part 2, Protocol 2d



Crown Ratio Reference Card: Canopy Part 2, Protocol 2d

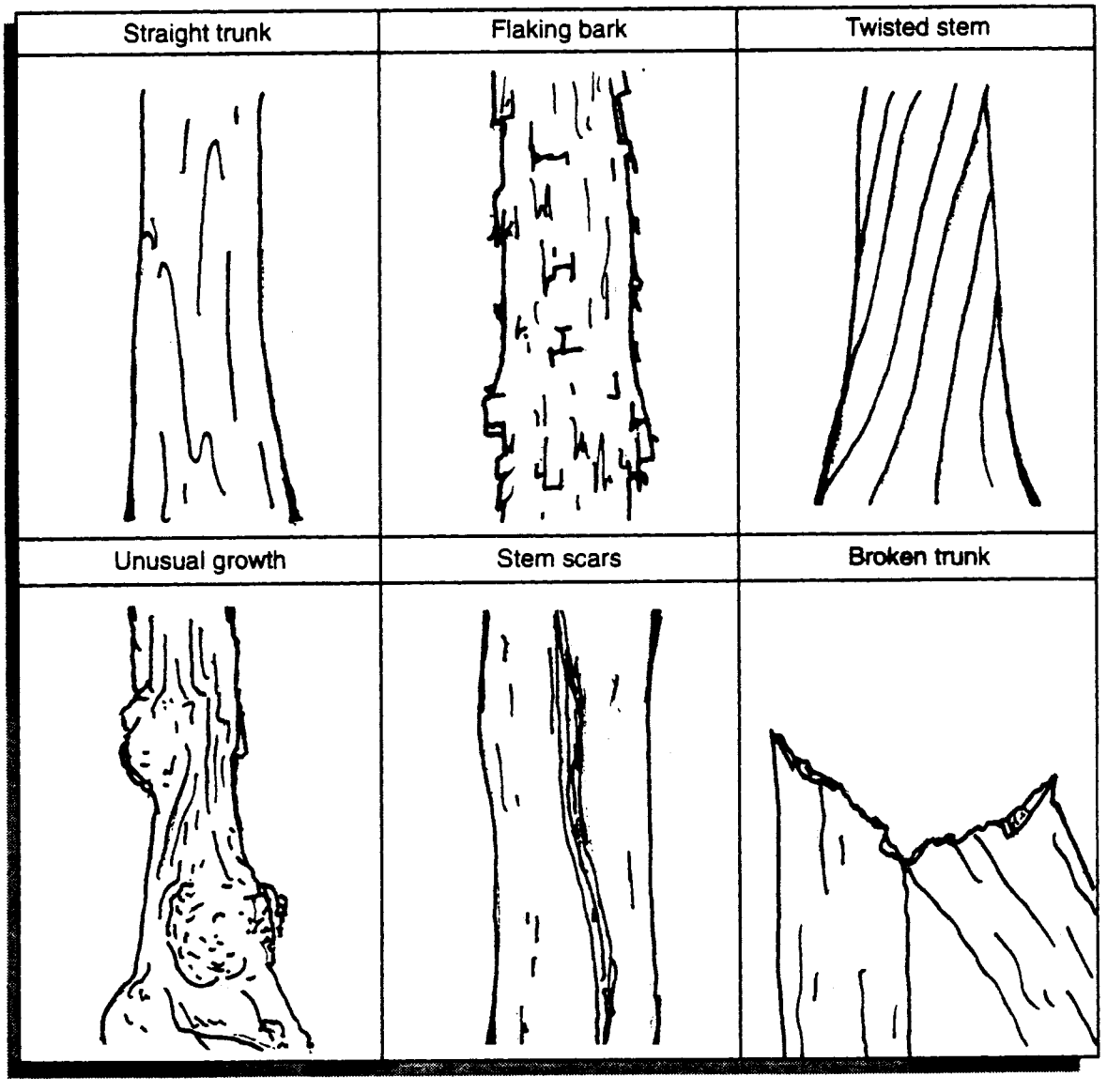
The Crown Ratio is an estimate of the percentage of the tree's height that is crown. In the examples below,

Crown Ratio = (X/Y)* 100



Trunk Condition Reference Card: Canopy Part 2, Protocol 2d

Code	Characteristics
ST	Straight Trunk. No obvious stem deformities
BT	Broken Trunk.
TS	Twisted Stem.
UG	Unusual Growth. This includes woody burls, stem cankers, etc.
SC	Stem Scars. Longer than 1 m.
OT	Other. Please describe anything unusual.



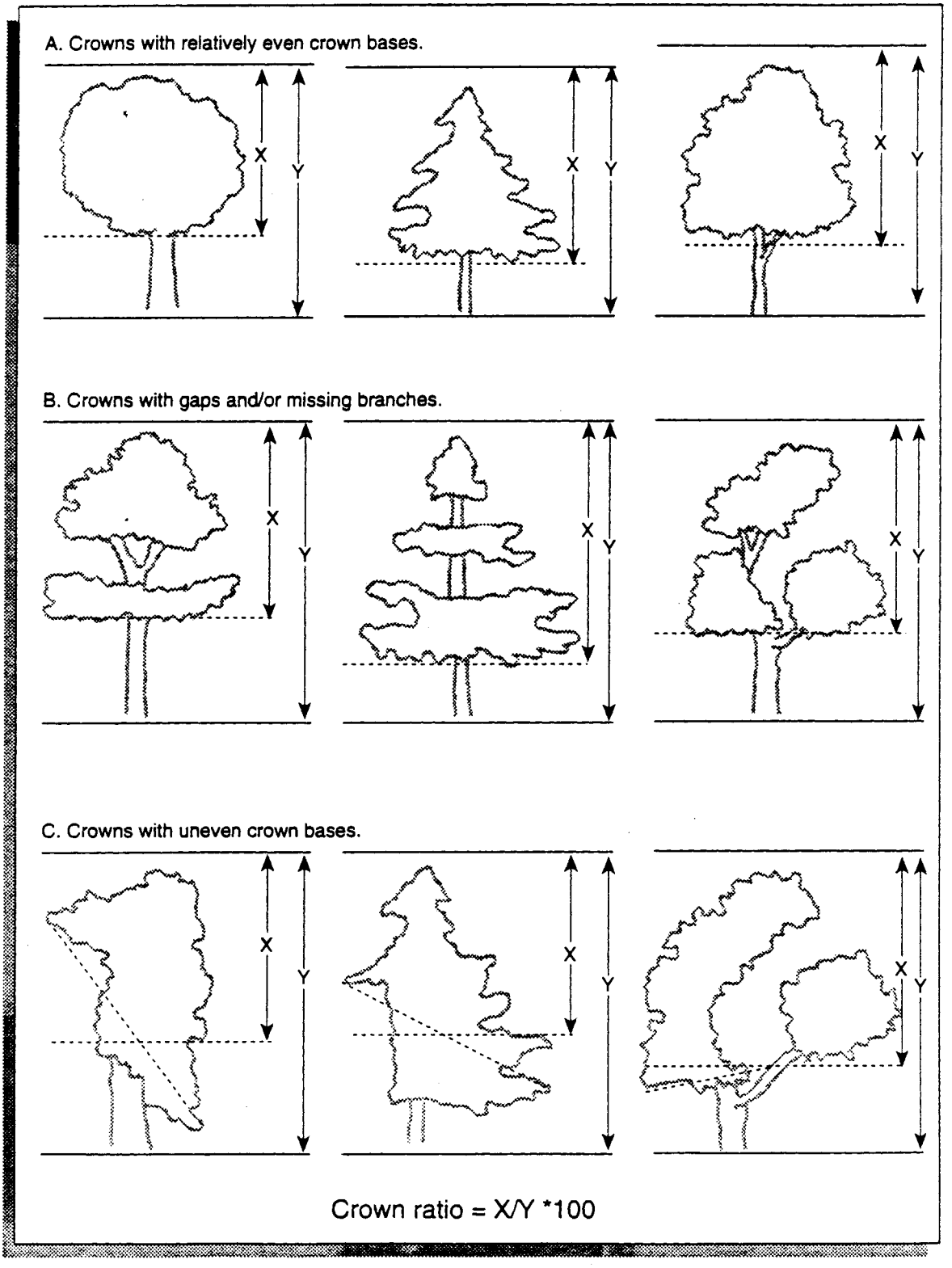
Vigor Class Reference Card: Sapling Part 2, Protocol 2d

Class	Criteria
1.	1. Greater than one-third of tree height has leaves. 2. No dead branches in upper half of crown. 3. More than 75% of the leaves are normal, meaning that they are not chewed up, skeletonized or deformed.
2.	Meets two of the three criteria listed above.
3.	Meets one of the three criteria listed above.
4.	Meets none of the three criteria listed above.

Crown Ratio Reference Card: Sapling Part 2, Protocol 2d

The Crown Ratio is an estimate of the percentage of the tree's height that is crown. In the examples below,

Crown Ratio = (X/Y)* 100



Title: Part 2, Protocol 2e -- Surveying for disturbance-sensitive plant species.

Question: Are certain plant species disappearing from Illinois' forests?

Goal: To detect changes in the abundance of native plant species known to be particularly sensitive to human disturbance.

Purpose: One of the goals of forest managers in Illinois is to maintain biological diversity. Biological diversity refers to the variety of life that occurs at all levels of biological organization. Sometimes it refers to the diversity of genes in a population. For example, if you consider your class to be a population, you can count part of its genetic diversity by tallying the different eye colors of the people in your class (assuming that your classmates don't wear colored contacts). Sometimes it refers to the variety of species in an area. For example, you may try to count the number of species of organisms in your classroom -- from the silverfish that hide in the drain of the sink to the plants on the counter. Sometimes it refers to the variety of ecosystems in an area. For example, you may try to count the different areas around your school, such as a nearby patch of woods, a stream, and a field.

One aspect of biodiversity that is of particular concern is the abundance of native species in an area. Native species are those species that evolved in Illinois. Generally, they are the species that were here before Europeans settled the state. Many of our native flowering plants are good indicators of the quality of our forests. These species are often the first to disappear when a forest is used for grazing, when the first non-native species invade, or when air pollution starts affecting a forest. Consequently, tracking the abundance of these plants is one good way to record the changes in the ecological health of Illinois forests.

The six species of plants which you will be surveying are especially sensitive to changes in the environment brought about by humans and may serve as good indicators for what is happening to other native plants in Illinois. If you find these plants to be abundant or increasing over time, this may be a sign that your study site is in good condition or improving.

Materials:

110 m long rope knotted at 10 m intervals (or, recommended, a 100 m measuring tape)
4 Sturdy pieces of string, 7.5 m long with a large loop on one end
2 (or 4, if available) meter sticks
Species Reference Cards
Data Sheet
Clipboard
Pencil

Procedure:

1. Read all of the steps in the procedure and assign members in your group the following roles. If you don't have at least five people in your group, you may take on more than one role. Alternatively, your teacher may wish to assign you to a specific role or two. The roles are:

Facilitator -- makes sure that the group quickly and accurately completes the protocol by having individuals fulfill their particular tasks.
Recorder -- accurately (and legibly) completes the data sheets.
Botanists -- each identifies and inventories the occurrence of two or more target species along the transect.

2. Gather the materials listed above for your group. Locate your transect and run a rope that is knotted every 10 m between the stakes that mark its beginning and end. (You may have already done this. If not, check the instructions for doing this in Part 2, Protocol 1). Alternatively, you may use a 100 m measuring tape.

3. The Botanists are responsible for documenting the presence or absence of their particular species in each 10 m segment of the transect. If the species occurs in that segment they then must estimate the density of that species.

Documenting the presence or absence of a species --

Use the Species Reference Cards to learn about each plant. Make sure you are familiar with all of the small details that let you separate your particular species from species that are similar to it. In other words, if you are the botanist for Blue Cohosh and Maidenhair Fern, you will learn to recognize, and then look for those two species.

Start in the first segment, the one that runs from 0 to 10 m. Look for your species and record if it is present or absent.

Make sure that you check the ground up to 7.5 m from either side of the line which marks the transect. The people working on other transects will do likewise, and because the transects are 15 m apart, all of the nearby ground should be covered.

To make sure that you are looking only in the area 7.5 m from the transect, take the 7.5 m long pieces of string and slip their loops over the transect line. Position the strings so that two are at the 0 m mark and two are at the 10 m mark. Arrange them so that they are perpendicular to the transect. Be sure to stay within the boundaries of these strings when you search for your species. Check out Figure 1.

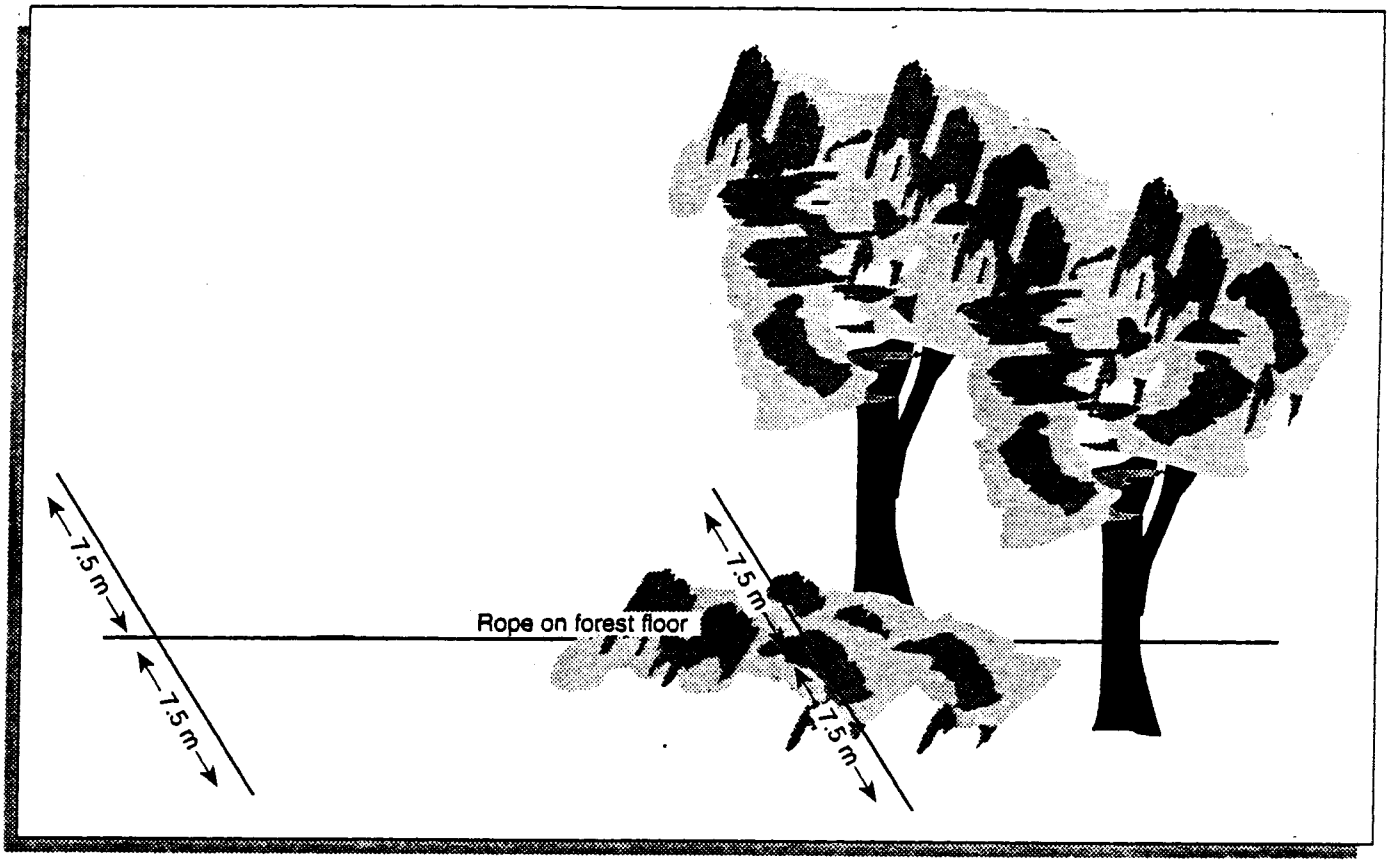


Figure 1. Use the 7.5 m strings to define the boundaries of the 10 m x 15 m plot.

HINT: When you are counting plants, count only those that are rooted in the area where you are looking. Also, if you see several stems coming out of one point in the soil, count all of those stems as a single plant.

Repeat this process so that you note the presence or absence of your species in each 10 m segment of the transect. You should end up at the 100 m point on the transect.

Now you will back track along the transect. For each of the 10 m segments which contained your particular species, you need to estimate the density of the species. Density refers to the number of individuals in a certain area.

Determining the density of a species if it is present --

You will first estimate the density by counting the number of individuals in that portion of the transect which is within 1 m of the transect line. Take a meter stick and hold it perpendicular to the transect line. Walk the 10 m segment and count every individual of your species that is rooted within a meter of the transect line. Take a look at Figure 2 for a better idea of how it is done.

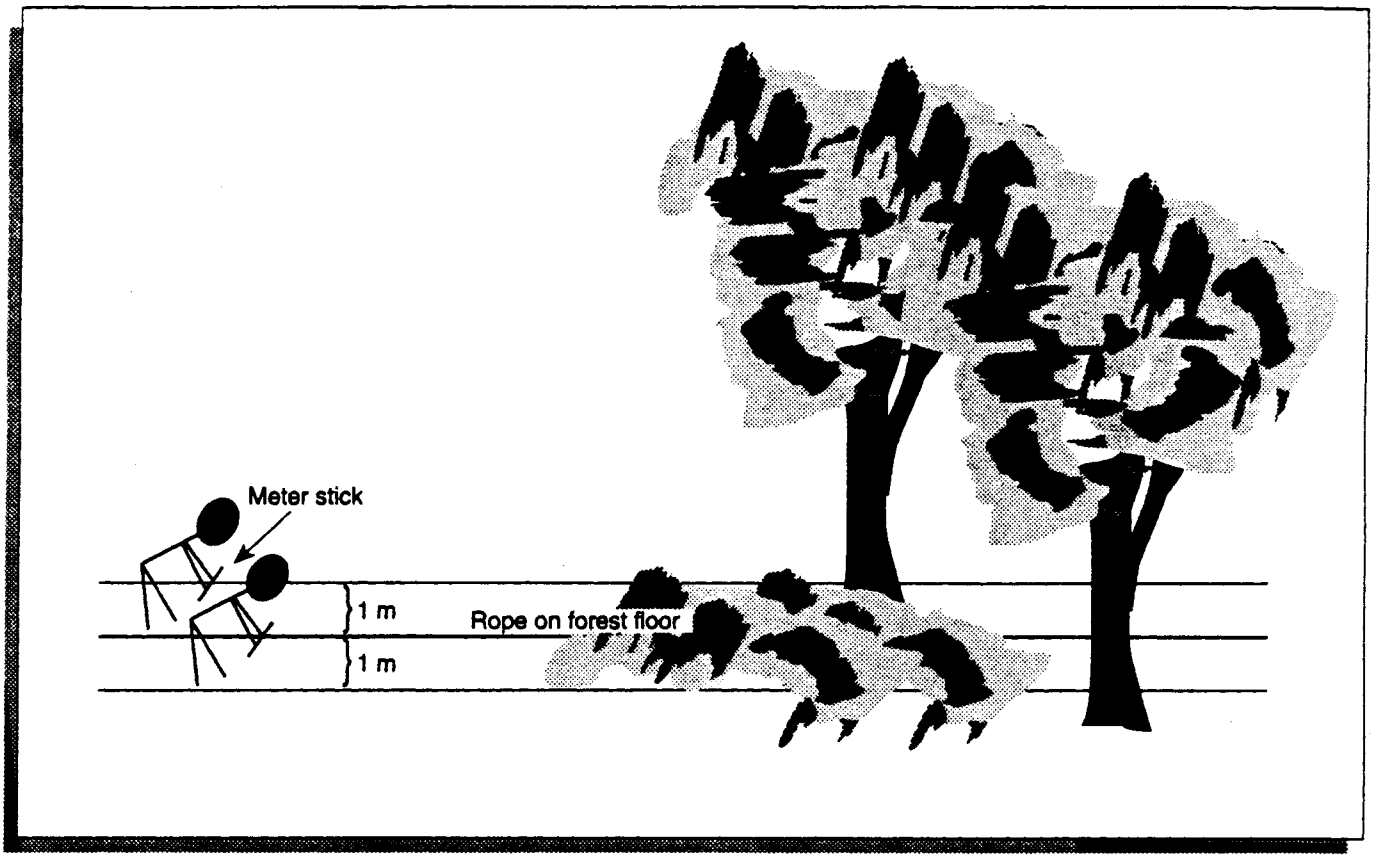


Figure 2. Walk with a meter stick perpendicular to the transect line and count the number of plants which pass underneath it.

In some cases, you may have found the plant in the 10 x 15 m segment of the transect, but not within the 10 x 2 m segment centered on the transect line. That is OK, simply note that 0 plants are growing within a meter of the transect line.

In contrast to this, you may find some plants that are extremely abundant. In fact, there may be so many that they will be difficult to count. Consequently, if there are more than 100 individuals (in some cases there may be thousands!), you have to use a different technique.

For species that have more than 100 individuals in the 10 m long by 2 m wide strip centered on the transect line, you will estimate the density by measuring the area occupied by 100 individual plants.

To accomplish this task begin at the start of your 10 m segment. Using your meter stick, slowly move forward with your meter stick perpendicular to the transect with one end on the transect line. Count all of the plants that cross under the meter stick. When you reach 100, stop and record the length of the transect lien over which you counted plants (This will be extremely easy if you used a measuring tape instead of a rope when you laid out your transect). For example, if you started at the 10 m mark and counted 100 plants by the time you got to 14.2 m, then you sampled 4.2 m^2. Check out Figure 3.

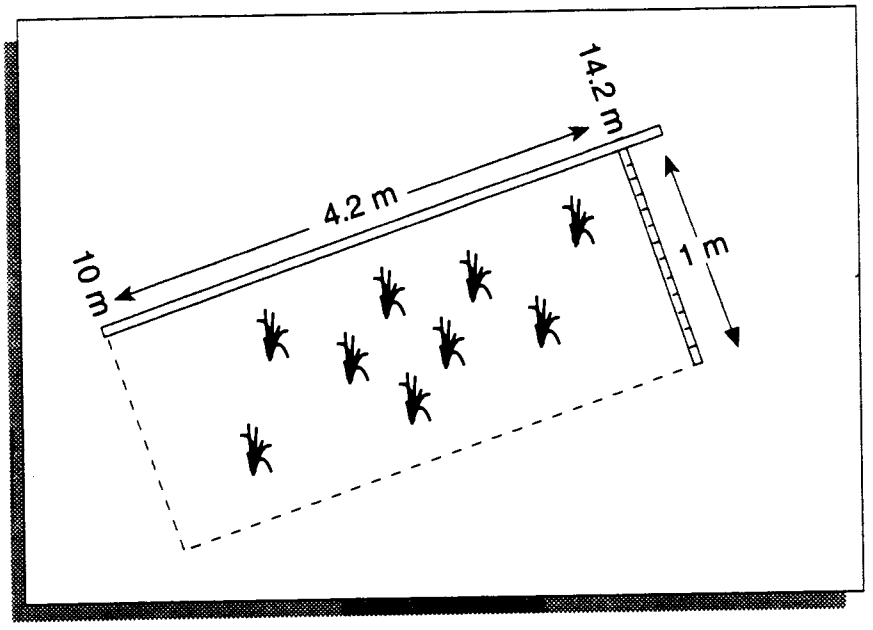


Figure 3. For dense stands of plants, determine the area occupied by 100 individuals using this method. The area will be the distance you move along the measuring tape (the length) multiplied by 1 m (the width).

Record your estimates of the numbers of individuals of each species, as a number if there are less than 100 in a 2 m x 10 m patch, or as the area needed to contain 100 individuals if there are more.

Repeat this procedure for all of the species in your region. If you are sampling in a forest that is north of Effingham, Illinois then you should look for Blue Cohosh, Maidenhair Fern, Small Bellwort, Doll's-eyes, White Trillium, Bleeding-hearts. If you are sampling a forest that is south of Effingham, Illinois then you should be looking for Blue Cohosh, Maidenhair Fern, Small Bellwort, Doll's-eyes, Yellow Trout Lily, and Spiderwort in each 10 m segment of the transect.

4. If you have enough time, repeat these procedures on another transect. Ask your teacher which transect would be most useful for you to work on next.

5. Turn in the tools and data sheet. Congratulations, you are done with this protocol! Plan on preparing your data for submission to the Illinois ForestWatch coordinator.

Task Checklist: Part 2, Protocol 2e

Use this checklist to make sure that you have completed all of the tasks in the protocol.

Everyone should...

- ❑ Read all of the steps in the procedure and take on the various roles.
- ❑ Gather the materials needed to complete the protocol.

The Facilitator should...

- ❑ Help everyone to complete their tasks and keep them focused on the tasks.

The Recorder should...

- ❑ Make sure that all of the data is gathered and legibly recorded.

The Botanist for Blue Cohosh and Maidenhair Fern should...

- ❑ Document the presence or absence of Blue Cohosh and Maidenhair Fern in each 10 m segment of the transect.
- ❑ Determine the density of Blue Cohosh and Maidenhair Fern, if they are present.

The Botanist for Small Bellwort and Doll's Eyes should...

- ❑ Document the presence or absence of Small Bellwort and Doll's Eyes in each 10 m segment of the transect.
- ❑ Determine the density of Small Bellwort and Doll's Eyes, if they are present.

The Botanist for White Trillium and Bleeding-hearts (if you are in the northern part of the state) or Yellow Trout Lily and Spiderwort (if you are in the southern part of the state) should...

- ❑ Document the presence or absence of White Trillium and Bleeding-hearts or Yellow Trout Lily and Spiderwort in each 10 m segment of the transect.
- ❑ Determine the density of White Trillium and Bleeding-hearts or Yellow Trout Lily and Spiderwort, if they are present.

After completing the protocol, everyone should...

- ❑ Prepare the data for submission to the ForestWatch Coordinator

Data Sheet: Part 2, Protocol 2e

Date	

Name	Role
1.	
2.	
3.	
4.	
5.	

Site Location	
County:	
Township Name:	
Township (ex. T12S):	
Range (ex. R4W):	
Section Number:	
Transect Letter	

Botanists' Data Sheet: Part 2, Protocol 2e

Mark whether each species is Present (Y for Yes and N for No) in each 10 m long by 15 m wide segment of the transect.

For those species that are present in a 10 m segment, estimate the density. Record the number of individuals if there are less than 100 within a meter of either side of the transect line. If there are more than 100, record the area that contains 100 individuals.

Transect Segment 0 - 10 m	Present?	Density	
		Number **or**	Area
Blue Cohosh	Y or N		
Maidenhair Fern	Y or N		
Small Bellwort	Y or N		
Doll's Eyes	Y or N		
White Trillium (N) **or** Yellow Trout Lily (S)	Y or N		
Bleeding-hearts (N) **or** Spiderwort (S)	Y or N		

Transect Segment 10 - 20 m	Present?	Density	
		Number **or**	Area
Blue Cohosh	Y or N		
Maidenhair Fern	Y or N		
Small Bellwort	Y or N		
Doll's Eyes	Y or N		
White Trillium (N) **or** Yellow Trout Lily (S)	Y or N		
Bleeding-hearts (N) **or** Spiderwort (S)	Y or N		

Transect Segment 20 - 30 m	Present?	Density	
		Number **or**	Area
Blue Cohosh	Y or N		
Maidenhair Fern	Y or N		
Small Bellwort	Y or N		
Doll's Eyes	Y or N		
White Trillium (N) **or** Yellow Trout Lily (S)	Y or N		

Bleeding-hearts (N) **or** Spiderwort (S)	Y or N		

Transect Segment 30 - 40 m	Present?	Density Number	**or**	Area
Blue Cohosh	Y or N			
Maidenhair Fern	Y or N			
Small Bellwort	Y or N			
Doll's Eyes	Y or N			
White Trillium (N) **or** Yellow Trout Lily (S)	Y or N			
Bleeding-hearts (N) **or** Spiderwort (S)	Y or N			

Transect Segment 40 - 50 m	Present?	Density Number	**or**	Area
Blue Cohosh	Y or N			
Maidenhair Fern	Y or N			
Small Bellwort	Y or N			
Doll's Eyes	Y or N			
White Trillium (N) **or** Yellow Trout Lily (S)	Y or N			
Bleeding-hearts (N) **or** Spiderwort (S)	Y or N			

Transect Segment 50 - 60 m	Present?	Density Number	**or**	Area
Blue Cohosh	Y or N			
Maidenhair Fern	Y or N			
Small Bellwort	Y or N			
Doll's Eyes	Y or N			
White Trillium (N) **or** Yellow Trout Lily (S)	Y or N			
Bleeding-hearts (N) **or** Spiderwort (S)	Y or N			

Transect Segment 60 - 70 m	Present?	Density Number	**or**	Area
Blue Cohosh	Y or N			
Maidenhair Fern	Y or N			

Small Bellwort	Y or N		
Doll's Eyes	Y or N		
White Trillium (N) **or** Yellow Trout Lily (S)	Y or N		
Bleeding-hearts (N) **or** Spiderwort (S)	Y or N		

Transect Segment 70 - 80 m	Present?	Density	
		Number	**or** Area
Blue Cohosh	Y or N		
Maidenhair Fern	Y or N		
Small Bellwort	Y or N		
Doll's Eyes	Y or N		
White Trillium (N) **or** Yellow Trout Lily (S)	Y or N		
Bleeding-hearts (N) **or** Spiderwort (S)	Y or N		

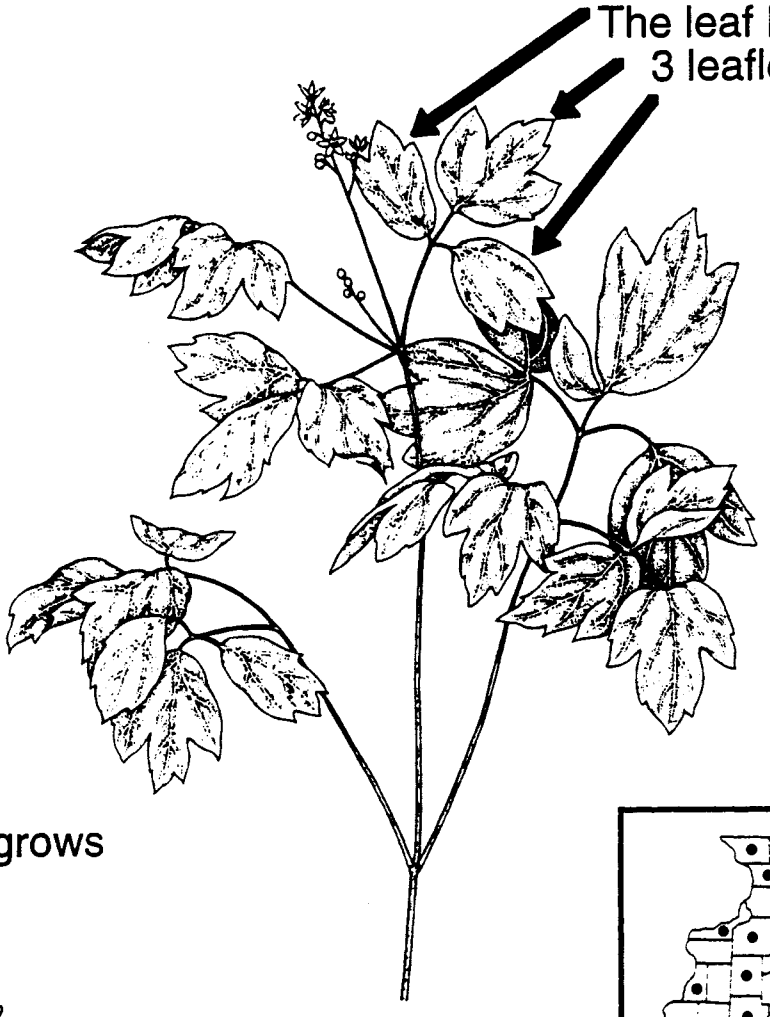
Transect Segment 80 - 90 m	Present?	Density	
		Number	**or** Area
Blue Cohosh	Y or N		
Maidenhair Fern	Y or N		
Small Bellwort	Y or N		
Doll's Eyes	Y or N		
White Trillium (N) **or** Yellow Trout Lily (S)	Y or N		
Bleeding-hearts (N) **or** Spiderwort (S)	Y or N		

Transect Segment 90 - 100 m	Present?	Density	
		Number	**or** Area
Blue Cohosh	Y or N		
Maidenhair Fern	Y or N		
Small Bellwort	Y or N		
Doll's Eyes	Y or N		
White Trillium (N) **or** Yellow Trout Lily (S)	Y or N		
Bleeding-hearts (N) **or** Spiderwort (S)	Y or N		

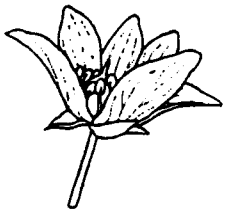
Blue Cohosh (*Caulophyllum thalictroides*) Reference Card

The fruit is a blue "berry".

The leaf has 3 leaflets.

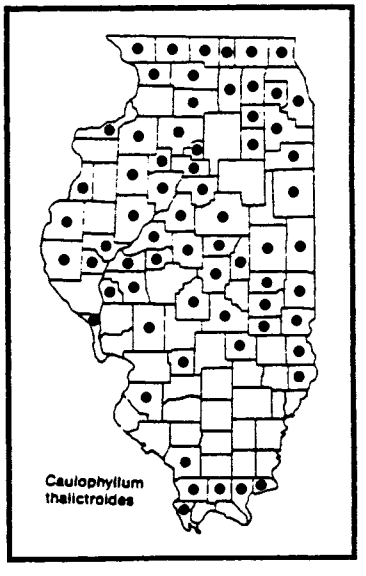


The plant grows to 1 m tall.

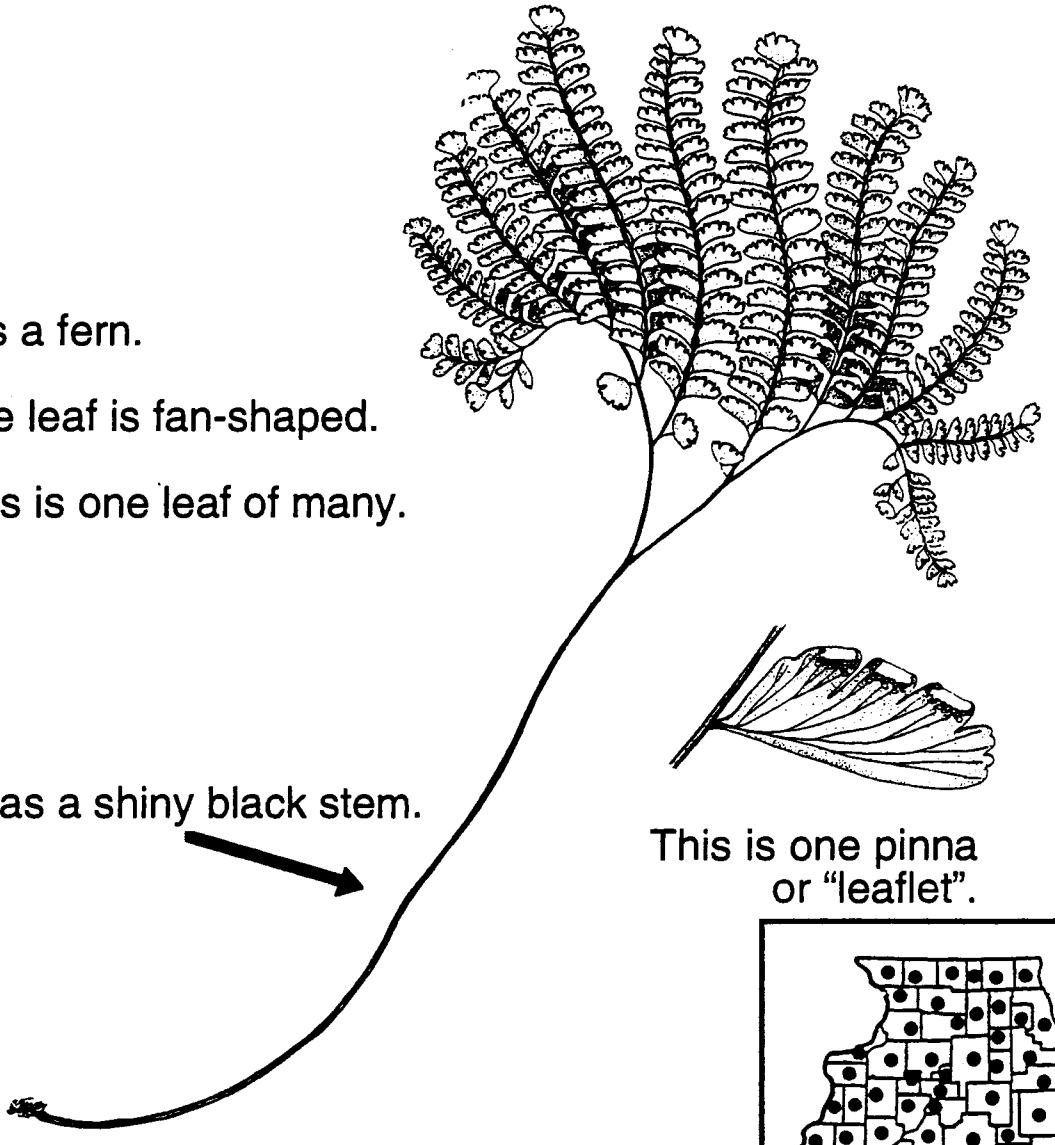


The flowers are greenish-yellow to greenish-purple.

These drawings are half life-size except the flower which is life-size.



Maidenhair Fern (*Adiantum pedatum*) Reference Card



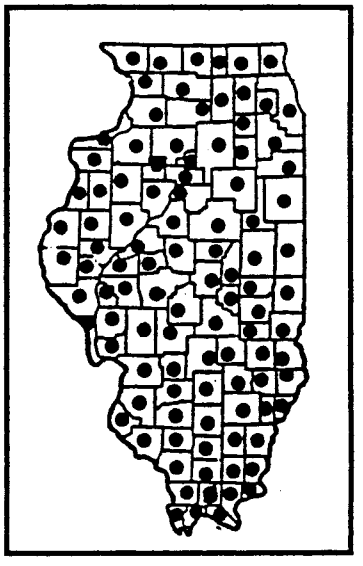
It is a fern.

The leaf is fan-shaped.

This is one leaf of many.

It has a shiny black stem.

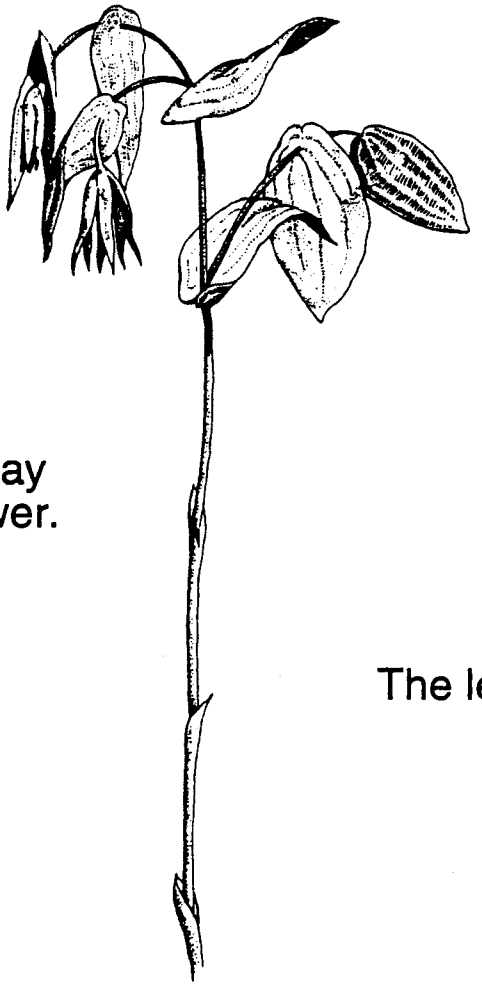
This is one pinna or "leaflet".

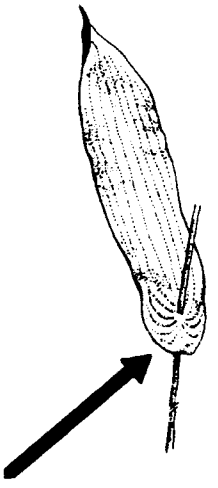


These drawings are half life-size.

Small Bellwort (*Uvularia grandiflora*) Reference Card

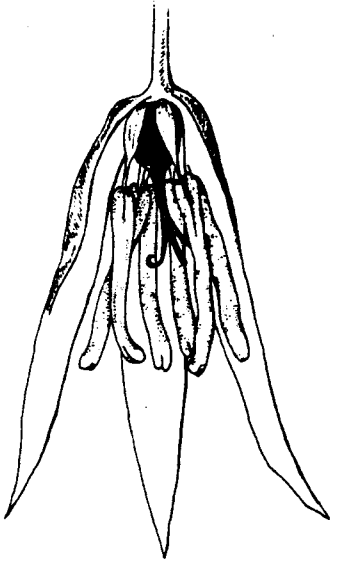
The flower is bright yellow.



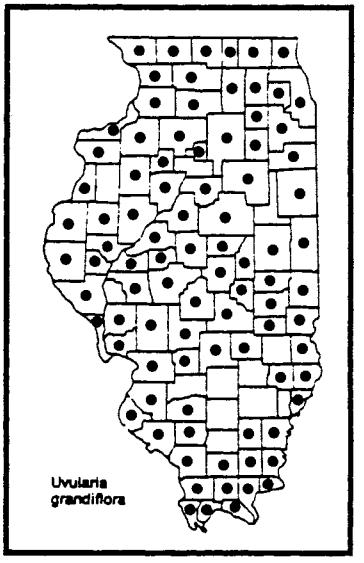


The leaves encircle the stem.

This is a cutaway view of the flower.

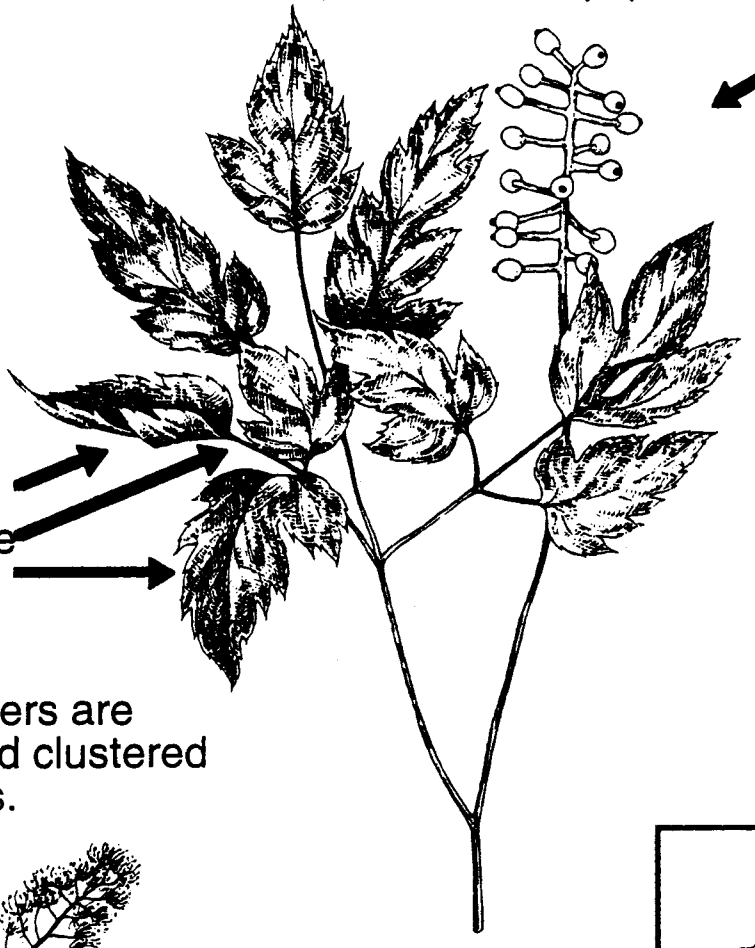


These drawings are approximately one-quarter life-size, except the flower which is life size.



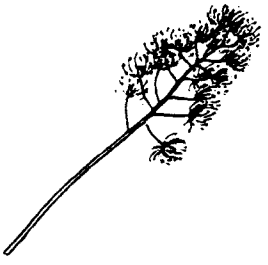
Doll's-eyes (*Actaea pachypoda*) Reference Card

The berries are white with a purple tip (doll's eyes!).

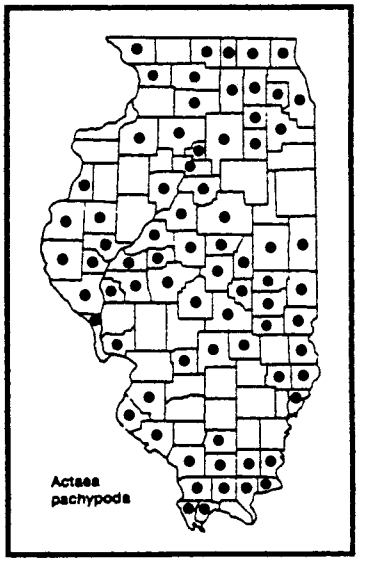


The leaf has three leaflets.

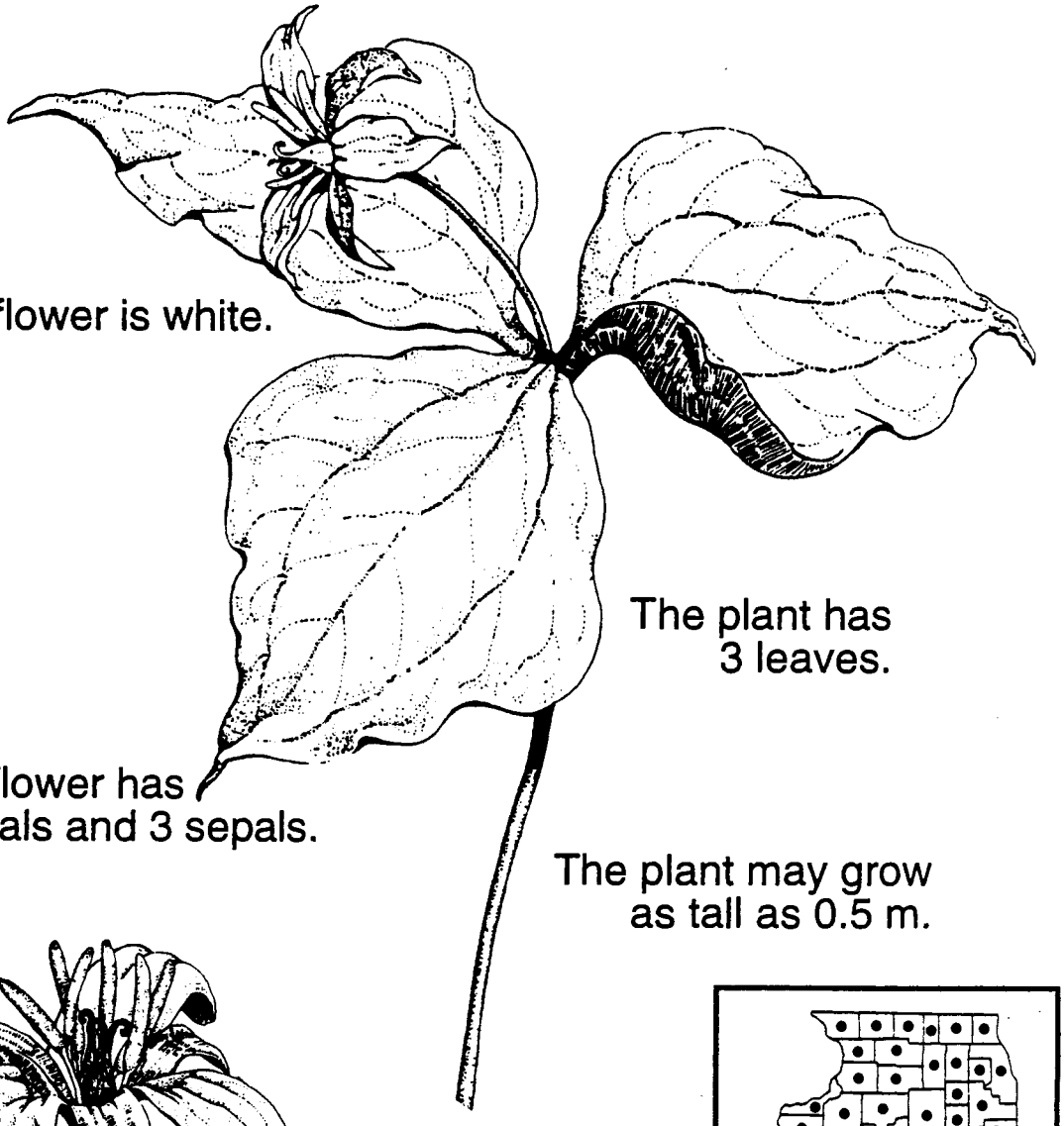
The flowers are white and clustered on stalks.



These drawings are approximately half life-size.



White Trillium (*Trilium flexipes*) Reference Card

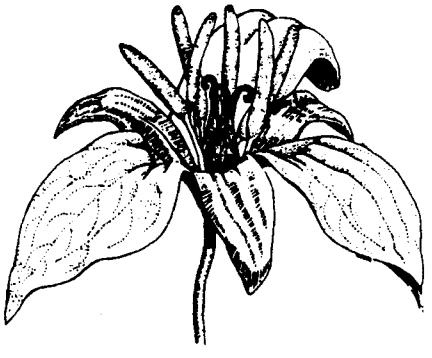


The flower is white.

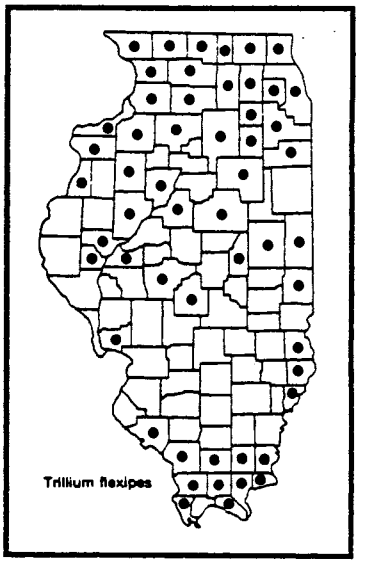
The plant has 3 leaves.

The flower has 3 petals and 3 sepals.

The plant may grow as tall as 0.5 m.



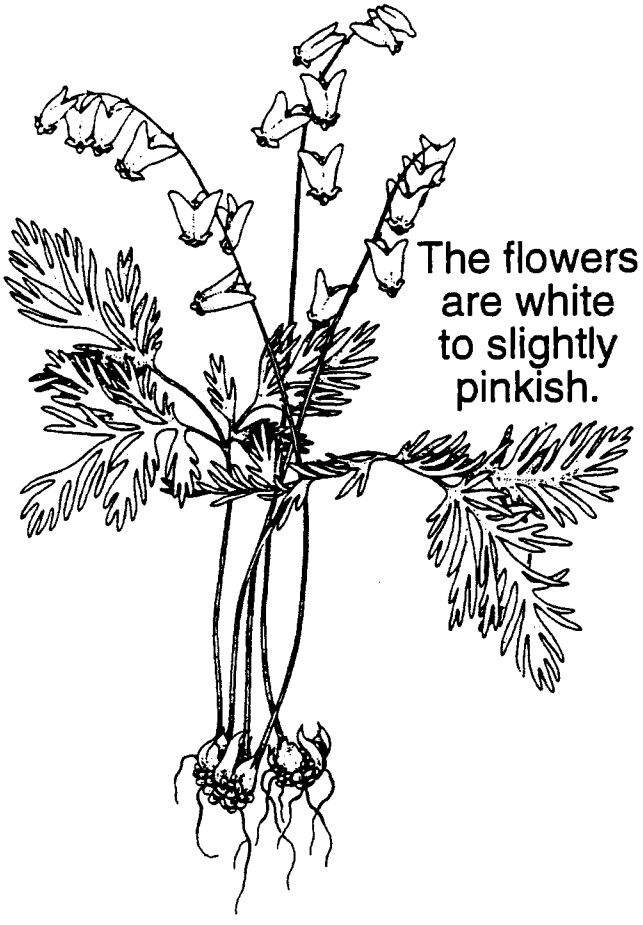
These drawings are approximately half life-size .



Bleeding-hearts (*Dicentra spp.*) Reference Card

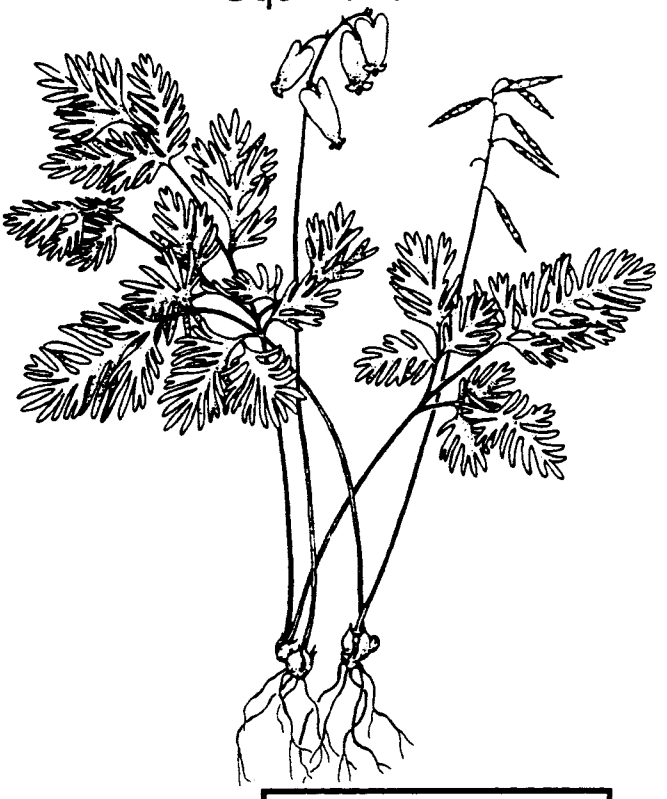
There are two species of bleeding-hearts.

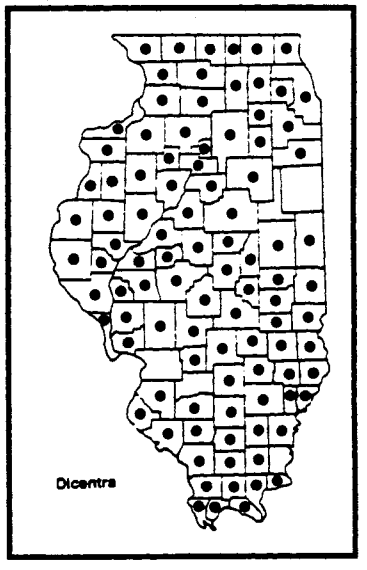
Dutchman's-breeches



The flowers are white to slightly pinkish.

Squirrel-corn

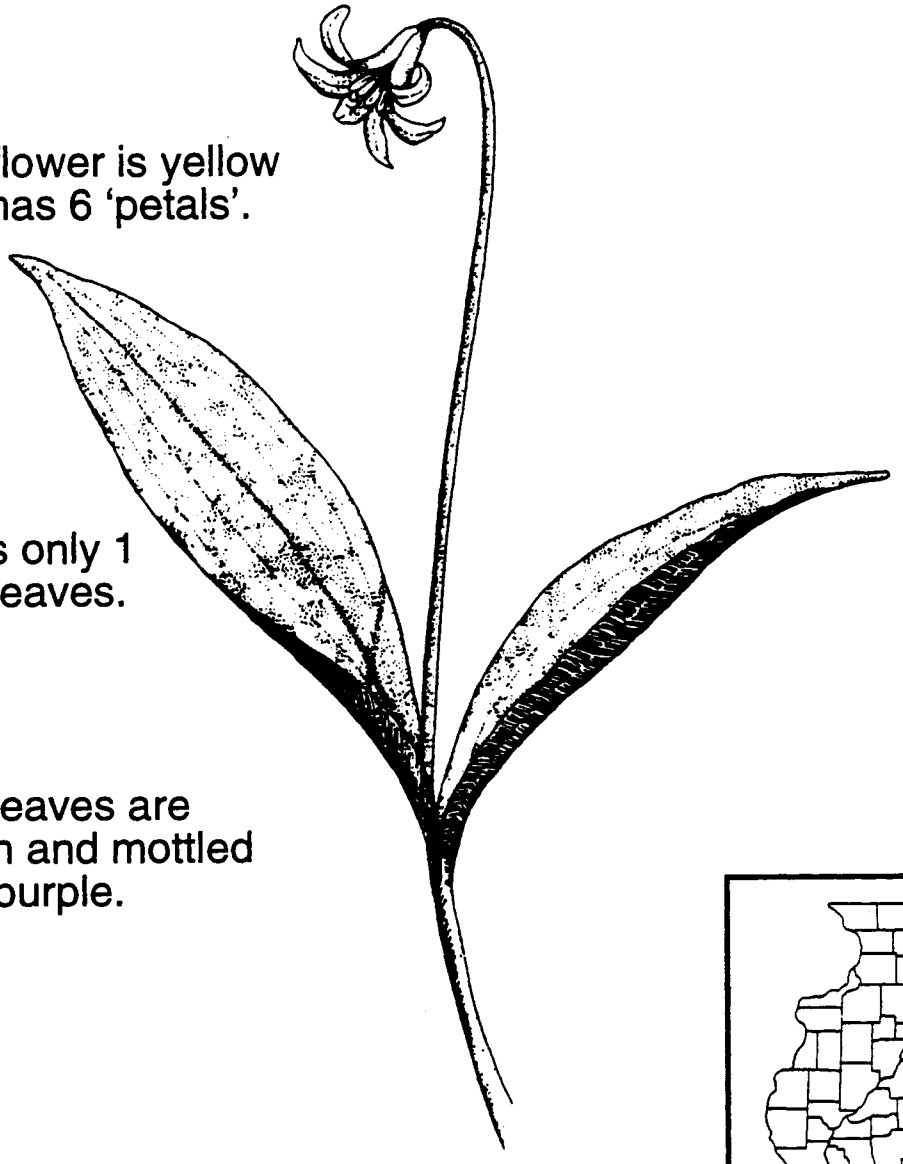




These drawings are half life-size .

Yellow Trout Lily (*Erythronium americanum*) Reference Card

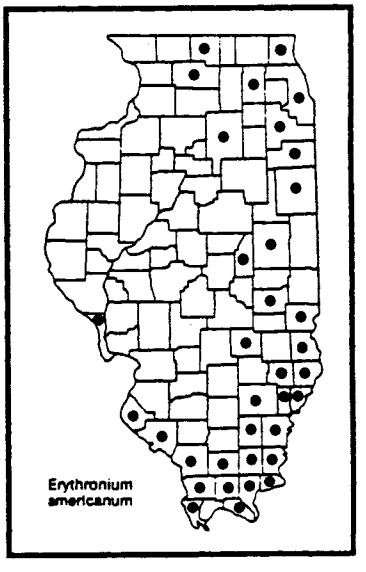
The flower is yellow and has 6 'petals'.



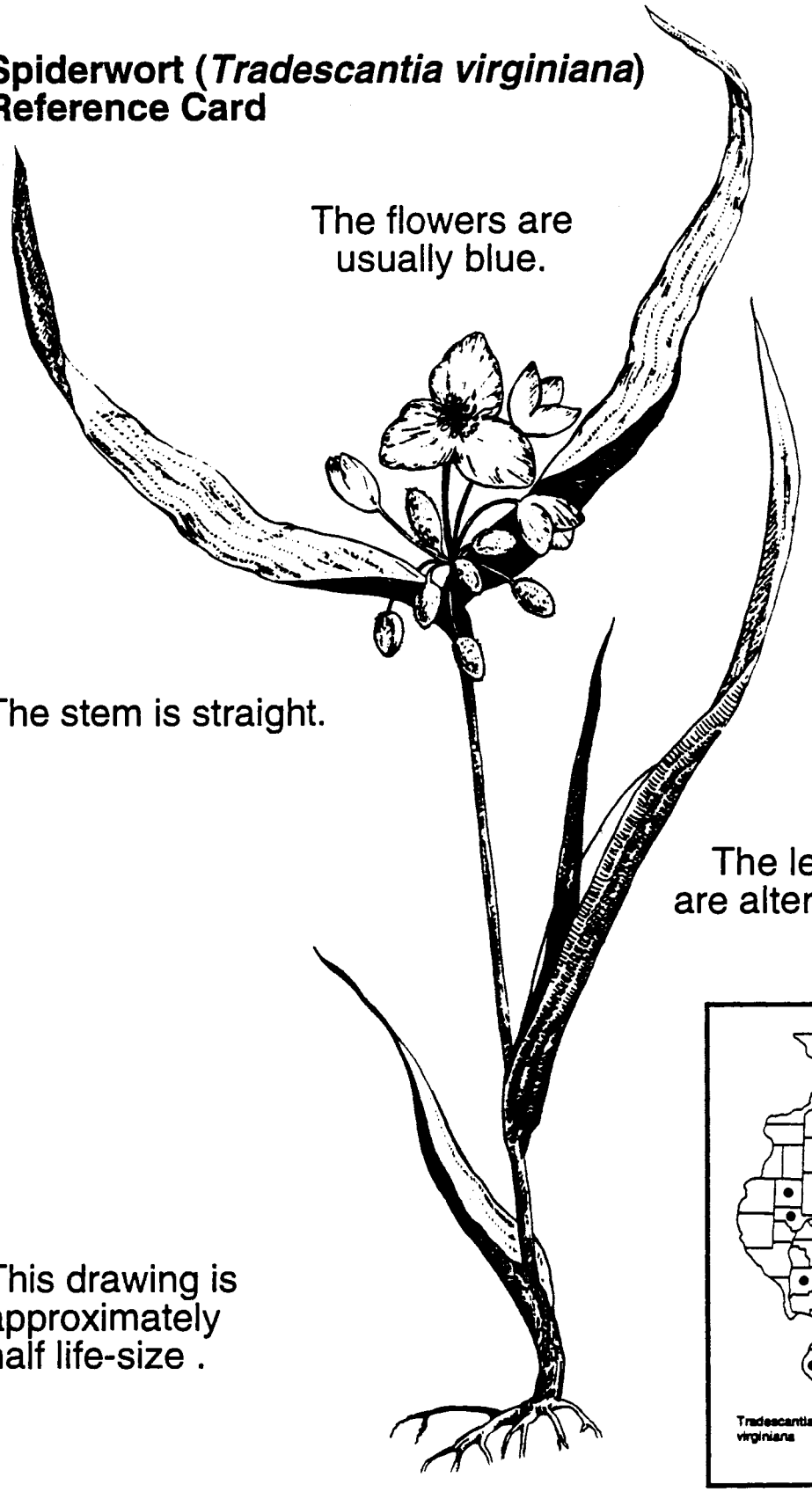
It has only 1 or 2 leaves.

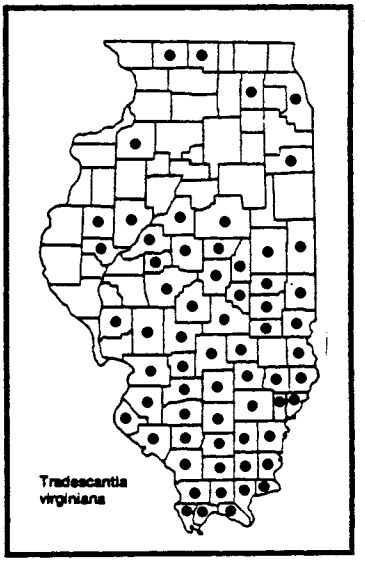
The leaves are green and mottled with purple.

This drawing is approximately life-size .



Spiderwort (*Tradescantia virginiana*)
Reference Card





Title: Part 2, Protocol 2f -- Surveying for signs of human use.

Question: What signs give an indication of how animals, including humans, use the forest and how this use affects forest quality?

Goal: To detect changes in the use of the forest by animals, especially humans.

Purpose: In this protocol, you will look and listen for signs of animal life and for signs that humans are making use of the forest. In many respects this protocol is least rigid of the ForestWatch activities because it is hard to strictly define all of the ways that animals and humans will make use of the forest. You will wander beyond the area defined by the six transects in the forest where most sampling has been done to make a broader assessment of overall forest quality.

To accomplish this task you will meander through the forest, covering as much territory within 200 meters of the transects as possible. You should tally observations as suggested on the data sheets and you should also define other observations which you think are important in telling the story of how humans use this forest. In particular, we would like you to look for signs of past and present forest management as well as use of the forest by animals.

Materials: (for each group member)

110 m rope knotted at 10 m intervals (or 100 m measuring tape)
Compass
Site map (or sketch)
Whistle
Watch
Stationary Listener or Wandering Observer Data Sheet
Pencil
Clipboard

Procedure:

1. Read all of the steps in the procedure and assign members in your group the following roles. If you don't have five people in your group, you may take on more than one role. Alternatively, your teacher may wish to assign you to a specific role or two. The roles are:

Facilitator -- One person who makes sure that the group quickly and accurately completes the protocol by having individuals fulfill their particular tasks. Also makes sure that all of the data sheets are filled out legibly and completely.

Stationary Listeners-- Two people who will each sit alone quietly in the forest and record sounds during 15 minute intervals.

Wandering Observers -- Two people who will search the forest for signs of past and present human impacts as well as habitat use by animals.

2. Gather the materials listed above for your group. Locate your transect and run a rope that is knotted every 10 m between the stakes that mark its beginning and end. (You may have already done this.) You will not use the transect line for this protocol, but other groups will be doing studies on your transect.

3. Go to the 100 m point of the transect where you collected tree data for Part 2, Protocol 1. Take compass bearings perpendicular to the transect heading in either direction. These will be the general paths that you will follow to complete this protocol.

As a precaution, each individual, or sub-group that will venture out on their own will carry a compass, a site map, and a whistle. Do not hesitate to blow the whistle if you get lost. If you feel sheepish about blowing the whistle, remember that only your group and your coordinators will know why the whistle is being blown. Everyone else will think that it is a routine part of your protocol.

4. The stationary listeners will be responsible for listening and recording all sounds that they hear for 15 minute periods at 5 different locations in the forest.

Locate a comfortable observation point --

> Find a quiet and comfortable observation post at least 100 m from the transects and, if possible, at least 100 m away from any forest edge. Listeners will tally animal sounds over fifteen minute intervals.

Record any sounds that you hear --

> During each tally period you will record the number of squirrel and bird calls that you hear as well as any vertebrate animals you see. Your data sheet is very open ended. This means that you will need to create data categories for whatever sounds that you may be able to distinguish, though a few are already listed as suggestions.
>
> Listen carefully. Be sure that you sit still and remain very quiet. Trying to observe animals in the forest is a difficult task because they often scared by any human activity.
>
> Record observations of the weather on the data sheets during each observation period.

Move to a new site --

> After 15 minutes of data collection give yourself a five minute break, wander around a bit. Do not stray too far, but find a new comfortable place to stand or sit for your next observation period.

Repeat this procedure at least four times (for a total of five 15-minute periods) before rejoining your group at the transect.

5. The wandering observers will be responsible for walking through the forest and recording any signs of human disturbance and that they find during 5 different 15 minute periods.

Gauging your pace --

> You will observe many common forest attributes, like the number of cut stumps, squirrel nests as well as look for signs of human disturbance in the forest. But first, you must gauge your pace.

First, time how long it takes you to traverse the measured 100 m transect that you surveyed earlier. Be sure to walk slowly and take a moment every few steps to look up into the trees and observe. Do this twice and record the length of time it took you to do it. Now, estimate the number of km you could walk in an hour. Remember, 1 km is 1000 m or ten of these transects. Record this on the data sheet

Walk through the woods --

Now begin your walk through the woods. Try to head away from the transect area and avoid the people in your group who are listening for animals.

Walk for 15 minutes and then take a 5 minute break. Make a tally mark on the data sheet for any of the categories listed. If you see something that you think indicates how humans are using the forest but is not on the sheet, then create a new category, and tally it there.

You should wander through the forest away from the transects proper, and away from the general vicinity of the listeners because they require solitude to complete their task. There is neither a set direction to walk, nor a set distance to walk. The idea is to see as much of the forest as possible, including its center and edge. If the site is large, you should stay within 200 m of the transect ends.

One term on the list that you may not recognize is Prairie Grove Tree. A Prairie Grove Tree is a tree that grew in an open prairie or in a small cluster of trees. Trees that grow in the open tend to be shorter and wider than trees which grow in the forest because sunlight can reach all sides of these tress and, consequently, they send out branches in all directions. In contrast, trees that grow in the forest tend to be tall and skinny because they put their energy into reaching the forest canopy so that their leaves may be in direct sunlight. If you find a Prairie Grove Tree in the forest, then you can assume that it grew in an open environment when it was younger. You can also conclude that the forest surrounding you (and the tree) is younger than the Prairie Grove Tree.

Repeat this procedure at least four times (for a total of five 15-minute periods) before rejoining your group at the transect.

6. Turn in the tools and data sheet to your teacher. Congratulations, you are done with this protocol! Plan on preparing your data for submission to the Illinois ForestWatch coordinator.

Task Checklist: Part 2, Protocol 2f

Use this checklist to make sure that you have completed all of the tasks in the protocol.

Everyone should...

- ❑ Read all of the steps in the procedure and take on the various roles.
- ❑ Gather the materials needed to complete the protocol.

The Facilitator should...

- ❑ Help everyone to complete their tasks and keep them focused on the tasks.
- ❑ Make sure that all of the data is gathered and legibly recorded.

The Stationary Listeners should...

- ❑ Locate a comfortable observation point.
- ❑ Tally any sounds that you hear.
- ❑ Record observations of the weather during each listening period.
- ❑ Move to a new site.
- ❑ Repeat this procedure at least four times.

The Wandering Observers should...

- ❑ Gauge your pace.
- ❑ Walk through the woods for 15 minutes. Tally all observations of signs of animal and humans.
- ❑ Take a five-minute break.
- ❑ Repeat this procedure at least four times.

After completing the protocol, everyone should...

- ❑ Prepare the data for submission to the ForestWatch Coordinator.

Data Sheet: Part 2, Protocol 2f
Visual Survey of Land Use and Ecological Indicators

Date	

Name	Role
1.	
2.	
3.	
4.	
5.	

Site Location	
County:	
Township Name:	
Township (ex. T12S):	
Range (ex. R4W):	
Section Number:	
Transect Letter	

Stationary Listeners Data Sheet: Part 2, Protocol 2f.

Tally the number of sounds heard and animals seen. Several categories are suggested. Feel free to create additional categories based on specific identifications you are able to make (e.g. specific sounds such as Katydids) and animals observed.

Weather & Temperature: Circle the appropriate descriptor.

Cloud Cover	Precipitation	Temperature
sunny intermittent sun hazy cloudy	dry humid raining	below 50° F 50-60° 60-70° 70-80° 80-90° over 90° F

Characteristic Observed	15-Minute Observation Period				
	1	2	3	4	5
Squirrel calls					
Squirrels seen					
Bird song, Type A					
Bird song, Type B					
Insect Sound, Type A					
Automotive traffic					

Wandering Observers Data Sheet: Part 2, Protocol 2f.

Time to slowly walk 100 m: Trial 1)_____ Trial 2)_____
Calculated Pace: _____ km/hour

Attribute	15-Minute Sampling Interval				
	1	2	3	4	5
Fresh Cut Stumps					
Decayed Cut Stumps					
Trees with objects or initials carved into them					
Fresh tip-up mounds with roots					
Prairie grove trees					
Streams or lakes					
Small depressions with standing water					
Rocks larger than a basketball					
Cows					
Squirrel nests					
Cats					
Dogs					
Animal droppings					
People other than those in your class					
Hiking trails					
Vehicle trails					

Large Garbage -- heaps of cans and bottles, trash bags, cars, or appliances.					
Small Garbage -- cans and bottles.					

Title: Part 3, Protocol 1 -- Insect Census

Question: What is the abundance of the members of a selected group of insects?

Goal: To detect changes over time in the abundance of representative insect groups in the monitoring site.

Purpose: As pointed out in other protocols, the ecology of certain groups of animals are such that their presence, abundance, and diversity in woodlands may often reflect general, or specific, aspects of woodland health. There are some groups of insects that are common and diverse in Illinois forests, but whose relationship to forest health has been little studied. Any monitoring efforts you undertake with such groups will represent new information, and help scientists and volunteers develop new and better tools for biomonitoring. Given that different species within groups respond differently to the environment and that we do not know in advance whether any one species or subset of species may prove to be particularly important, this sort of census effort requires that volunteers be able to identify members of the target group to the level of species. By comparing the data gathered here to data gathered under other protocols, it may eventually be possible to identify certain species as having predictable relationships with certain types of environmental change. This is a long-term project, with results becoming informative only after several years' worth of data have been collected.

Materials:
Pencil
Clipboard
Insect Collecting Equipment
Insect Field Guide(s) or Taxonomic Keys
Map of Census Route or Study Site

Procedure:

1. Acquaint yourself with a detailed field guide to a group of Illinois insects.

   At present, the only species-level field guides available that can be used for insects found in Illinois forests are those for butterflies (and, to a much less detailed extent, moths) (Heitzman and Heitzman 1987, Shull 1987). There are presently plans for field guides of the Longhorn beetles (cerambycids) (Yanega and Bouseman in prep.) and bumblebees found in Illinois. There are also a very small number of insect groups associated with Illinois forests for which there are scientific works that allow one to identify all species, the most notable of which is a guide to the horse flies and deer flies (tabanids) of Illinois (Pechuman et al. 1983).

2. Choose a census methodology.

   As with other protocols in this manual, it is absolutely essential that censuses be carried out in the same place and time, using exactly the same techniques every year (though you might have as many as three or more different censuses within a year). As long as you can accomplish this objective, your data will always be useful and valuable, even if your techniques differ from other monitoring groups elsewhere. In other words, internal consistency of observation is vastly more important than consistency among observers at different sites, though the latter is still desirable. There is no single "correct approach." To make sure that

observations are in the same place each year, you should map the area in which your census is carried out.

Your choice of insect(s) will determine the censusing methodology. There are two broad procedural categories: (A) census routes and (B) trapping/baiting censuses.

Censusing Along A Route --

Of the insect groups listed above, all can be censused by means of a census route. When walking a census route, the goal is to get as accurate a count as possible for each species of the target group (e.g. butterflies, cerambycids, bumblebees) in each section of the route. Ideally, you should eventually become skilled enough at identification to recognize species without having to kill and collect specimens. The numbers for each species will be compared with the numbers of that same species in that same section of the route in subsequent years. Any physical or vegetational changes in the area between years should be noted.

If you are doing a census route, draw a map of the route dividing it into sections of different microhabitats, or natural landmarks, each with a record of time spent in each section (see diagram for an example of a census route map). Note that only times and not distances are included on the map. It is not important to maintain the same speed over the entire route. Generally, you should not be going any faster than a very slow walk (you're looking for insects, after all), especially in areas where there are flower patches (there may be times where you might need to spend a half hour or more searching an area only several yards long!). The total amount of time spent should be no less than 2 hours, and probably no more than 5 or 6 (too much temperature change from start to finish). The total amount of ground covered and the amount of time taken is largely up to you, as long as the same procedure is followed consistently, and you are comfortable with it.

Keep accurate records of weather conditions at the start of and during your census period. Be sure to include whether or not the sun was visible (even if temperature doesn't change). Many insects will become less active almost instantly if the sun goes behind a cloud, and they will not reappear until the sun comes out again. Make certain the exact time of day you are in each section of the route is recorded, and be as consistent as possible from year to year in date and weather conditions.

Using Baits and Traps --

The baits and traps that are best used for cerambycids, tabanids, and some moths and butterflies include:

(1) Blacklighting: An ultraviolet light will attract many moths and cerambycids. Someone staying near the light can capture and census target insects as they arrive. This is an excellent sampling technique, requiring only a white sheet, a blacklight, and a power source (some lights can be run off a car battery, via the cigarette lighter).

(2) Fermented fruit baits: Fruit baits can be used to attract and trap cerambycids and angle-winged butterflies. The trap is left unattended, for a period of between

two hours and two days, depending on the rate of capture (this will require test runs). Insects caught inside are counted by species. This is a simple technique, but doesn't attract a large diversity of species, and specimens can be rather messy.

(3) Tabanid traps: Tabanid traps are a special type of trap (somewhat elaborate to construct, but once built, it can be used for years -- this approach is for the truly dedicated) which attracts and traps only tabanids. Captured flies die in the traps and can be counted later.

Details of the various baits and trap types and specifics of their operation can be found in the appropriate source books mentioned in "For More Information" in the teacher's manual.

For trapping/baiting censuses, a map showing the placement and orientation of the trap/bait is all that is needed, along with the dates and times the trap was run (which should be as similar as possible each year).

When trapping/baiting, keep records on the weather conditions over the time the trap was in operation such as high and low temperatures and rainfall. You should be able to obtain this information from the nearest state weather station. Weather conditions will influence trap capture rates and they should be taken into account. Limiting the time the traps are run will minimize variability in conditions. In both types of census, long-term weather forecasts might help you adjust the timing slightly so each season the route and/or traps are run when conditions are dry, clear, and not unusually hot or cold.

It should be possible to carry out the same type of comparison as long as conditions and times of operation are similar between years.

3. Create a data sheet.

You should make your own, data sheets. The minimum amount of information you will need is as follows:

Recording census route data --

A cover sheet with a full map and description of the census route, and the time allotted to walk the route, section by section. This should be on file under the appropriate Site Code, and updated only if conditions change appreciably (e.g., if part of the route is paved or converted from one type of habitat to another, etc.). If such changes occur, keep the old map on file, and make certain that each year's data sheets make specific mention of which is the appropriate route map. Your cover sheet should also specify the equipment you use (e.g. 15-inch, large-mesh aerial net), and any unusual collecting techniques you may employ. Keep such techniques as consistent as possible between years.

Organize data sheets so that sightings from each section of the route are in chronological order, with time and weather annotations for each section as a unit.

For example:

DATE	28 May 1995	SITE CODE	DesPla003	TIME	0930-1245 CST

BUTTERFLY CENSUS TAKEN BY	Joe Volunteer	ROUTE	A

SECTION	SPECIES	# SEEN	TIME	WEATHER
A-1	Papilio glaucus	2 male	0930-0945	70 F, sunny, breezy
A-1	Polygonia interrogationis	1	0930-0945	70 F, sunny, breezy
A-2	Polygonia interrogationis	1	0945-0950	70 F, sunny, breezy
A-2	Polygonia sp.	1		70 F, sunny, breezy
A-3	Everes comyntas	4 male	0950-1015	72 F, sunny, breezy
-----			0945-0950	
A-11	Cercyonis pegala ssp	3	1230-1245	82 F, hazy, breezy

Note that if you can tell the sex of an individual, you should include this under the number seen. Avoid common names or abbreviations. If using common names or abbreviations make sure you include a master list on your cover page that gives the scientific names for each species so your notes can be "decoded" by other people. Also specify the reference you have used for your scientific names, as some of these can change over time, either species name or genus name (e.g., "Lycaena thoe" is now Lycaena hyllus, and "Euptychia cymela" is now Megisto cymela). If you know the genus but are uncertain of the species, just list it as "sp.", and if you know the species but can't tell which subspecies (in cases where there is more than one possibility), then simply enter "ssp.", as in the examples above.

You should note any physical or changes in vegetation between years. Also, you should be able to report differences in the date, time of day, and weather from year to year. If you can keep more detailed weather data (e.g. air pressure, humidity, actual wind speed), please do so.

Never hesitate to keep notes as to any unusual occurrences, uncertain identifications, or biological notes. For example, you should note if you encounter an insect on flowers of a known plant, or spot a female laying eggs, or find larvae feeding, or find a specimen dead in a spider web. Notes such as these, while harder to treat in a standardized, formal manner, can nevertheless be very useful and revealing.

Recording trap/bait data --

The same basic principles apply as above, though details will vary. The cover sheet will need to specify trap type, location, orientation, and dates/times of operation. For example:

DATE	28-29 May 1995	TIMES	2230-0200	SITE CODE	DesPla003

CERAMBYCIDS TRAPPED BY	Joe Volunteer	TRAP TYPE	UV Light

WEATHER	63 F, overcast, calm, half moon

SPECIES	# SEEN	# COLLECTED
Enaphalodes atomarius	2 male	1 - voucher #JV0034
Enaphalodes rufulus	1 male	1 - voucher #JV0035
Anelaphus moestus	2	0
etc.		

4. Collect and analyze your data.

For both types of census, population size of individual species will be assessed for temporal trends. It is tempting to compile a list of species censused each year and analyze changes in diversity. When working with insects, however, there are a great many species that are consistently present, but in such small numbers that they are only rarely encountered. Diversity values are very sensitive to presence/absence. Care must be taken not to "overinterpret" diversity data. We do not recommend this approach for studies with only occasional sampling.

Title: Part 3, Protocol 2 -- Leaf Damage Profiles

Question: What is the degree and type of herbivore leaf damage on major forest tree species, and how does this change over time?

Goal: To detect changes over time in the types and amounts of herbivore damage affecting different tree species as a measure of insect abundance, diversity and habitat use.

Purpose: There is a great deal of protocol that takes place out of sight in the crowns of trees, some of which may provide information on the health of the forest. Many insects eat, live in, and otherwise harm the leaves of trees because they can profit from the energy that trees put into their photosynthetic organs.

If you look at the leaves of a tree that has been heavily attacked by leaf herbivores, you should find that a large proportion of those leaves show moderate to severe damage and that this damage comes in very specific forms. Consequently, looking at the amount of damage to a tree's leaves can offer a great deal of useful information, even if the pests responsible for the damage (generally insects) are long since gone.

You may be able to use the specific nature of the damage to identify the pest(s) involved, but, usually, classifying leaf damage into broad categories provides sufficient information about the health of the tree without the somewhat tedious work of identifying every single pest on the tree.

In this protocol, you will identify the broad categories of damage that herbivores do to leaves. This is a much more detailed analysis of the forest canopy condition protocol which is described in Part 2 Protocol 2d of ForestWatch.

Materials:
Leaf Damage Reference Card
Several small boxes or bags
Hula Hoop
Map of trees being sampled
Tree Field Guide or Taxonomist's Key (from Part 2, Protocol 1)
Pencil
Clipboard

Procedure:

1. Within your transect site, find 4 or 5 small trees of a common forest species (use a field guide or the Taxonomist's Key and genus characteristics cards from Part 2, Protocol 1 to determine the genus). Select individual trees that are: 1) common types, and 2) in the smallest two size categories (5 - 12.5 cm or 12.5 - 25 cm in diameter). You will be looking at leaves on each tree separately. You will re-visit these same trees every time you perform the profile, so also make sure you have some way of knowing which trees you have sampled (i.e. record the distance along the transect line and the direction and distance away from the line for each tree).

2. You need to sample a minimum of 100 leaves from a target tree to make an herbivory profile. It is important to NOT bias the sample by focusing only on those leaves (or trees) which are greenest, largest, most intact, or most damaged.

To obtain an unbiased sample, use the hula hoop to outline a portion of one tree's leaves by looping a branch or several branches. Place the hula hoop over the tree canopy haphazardly, or randomly, by not choosing any particular portion of the canopy that you can reach. In general, this is most easily done with two people: one holds the sample hoop and one counts leaves. Count all of the leaves within the hoop. If there are fewer than 100 leaves repeat the step of placing the hoop haphazardly over a portion of the tree canopy and counting leaf damage until your tally after finishing a hoop exceeds 100.

Score each leaf for damage in the following categories, grouped by the type of health threat they may represent (see the leaf damage reference card for illustrations):

Major threats:

chewed -- removal of leaf surface area by herbivores (almost exclusively insects), working in from the edges. Chewed leaves can appear as anything from small, irregular "bites" to a complete stripping down to the midrib.

skeletonized -- removal of leaf surface by rasping away of soft leaf tissues, leaving veins only. This is commonly in the middle of the leaf, rather than the edges, and the most common agents are beetles (both larvae and adults) and moth larvae.

mined -- some insect larvae actually live between the upper and lower surfaces of the leaf, and chew burrows as they grow. Many create twisted, worm-shaped mines, others make more nearly circular mines, but at least initially they are "windows" in the leaf, as opposed to the holes left by skeletonizing. Late in the season, however, the thin remaining leaf surface can wear away, making it difficult to tell whether the original damage was a mine or skeletonizing.

galled -- a large variety of insects, mites, fungi and other microbes induce the formation of galls on leaves (as well as stems). Galls come in a wide variety of shapes and sizes, but all represent a hyper-development of plant tissues which forms unusual growths and swellings (in some ways, the plant equivalent of a tumor). The galls usually serve as a home for the pest.

Minor threats:

rolled or folded -- a number of pests (and some non-pests) will make temporary or permanent shelters by rolling the edges of a leaf together and binding them in place with silk. These shelters might not always involve actual destruction of leaf material. Rolling the leaf reduces the photosynthetic surface area and represents a potential stress for the tree.

burned -- a category for cases where portions of the leaf edge have prematurely dried and discolored (can also happen in conifers, where it appears as yellowing), which may represent physical damage from an earlier leaf wound, microbial agents, or acid rain. Since the exact cause is hard to identify, this can't be considered evidence for a major threat.

diseased -- any other case where the leaf was infected by microbes while still alive, which may be a symptom of weakened plant defenses. Often, tiny discolored spots may be the sites of wounds from fluid-feeding insects -- such as leafhoppers and aphids -- but these are often points of entry for diseases, and there's no easy way to

separate the two. As with the preceding category, it's hard to know whether these symptoms reflect a major threat.

Non-threat:

sliced -- an uncommon category characterized by a clean cut where a leaf has been either cleanly bitten through the middle by a browsing vertebrate, or had a semicircular slice removed by a leafcutter bee (very distinctive).

tattered or intact -- a leaf that escapes disease and herbivory might still be damaged just by physical wear and tear in the wind. This kind of normal wear can be best distinguished from genuine herbivore damage because there should be no real loss of leaf surface, just breaks and tears in the edges.

3. On the leaf damage tally sheet, place a check mark in the column for each damage class seen on each leaf: more than one type of damage can occur on the same leaf, so if you were to sum the number of leaves in each damage class plus intact leaves, this would sum to over 100%. For this reason, damage classes must be analyzed separately (i.e. 30% of leaves have skeletonizing damage, 25% have galls, etc.). Since insect damage to leaves accumulates as time goes on, this technique will be most informative when used late in the season (late August or early September), and least informative in May.

Each sheet should follow this example (from a diseased tree on the University of Illinois campus):

Date	July 10, 1996	Name	Jane Volunteer

Site Location	
County:	Champaign
Township Name:	Champaign City Township
Township (ex. T12S):	T19N
Range (ex. R4W):	R9E
Section Number:	36
Transect Letter	C

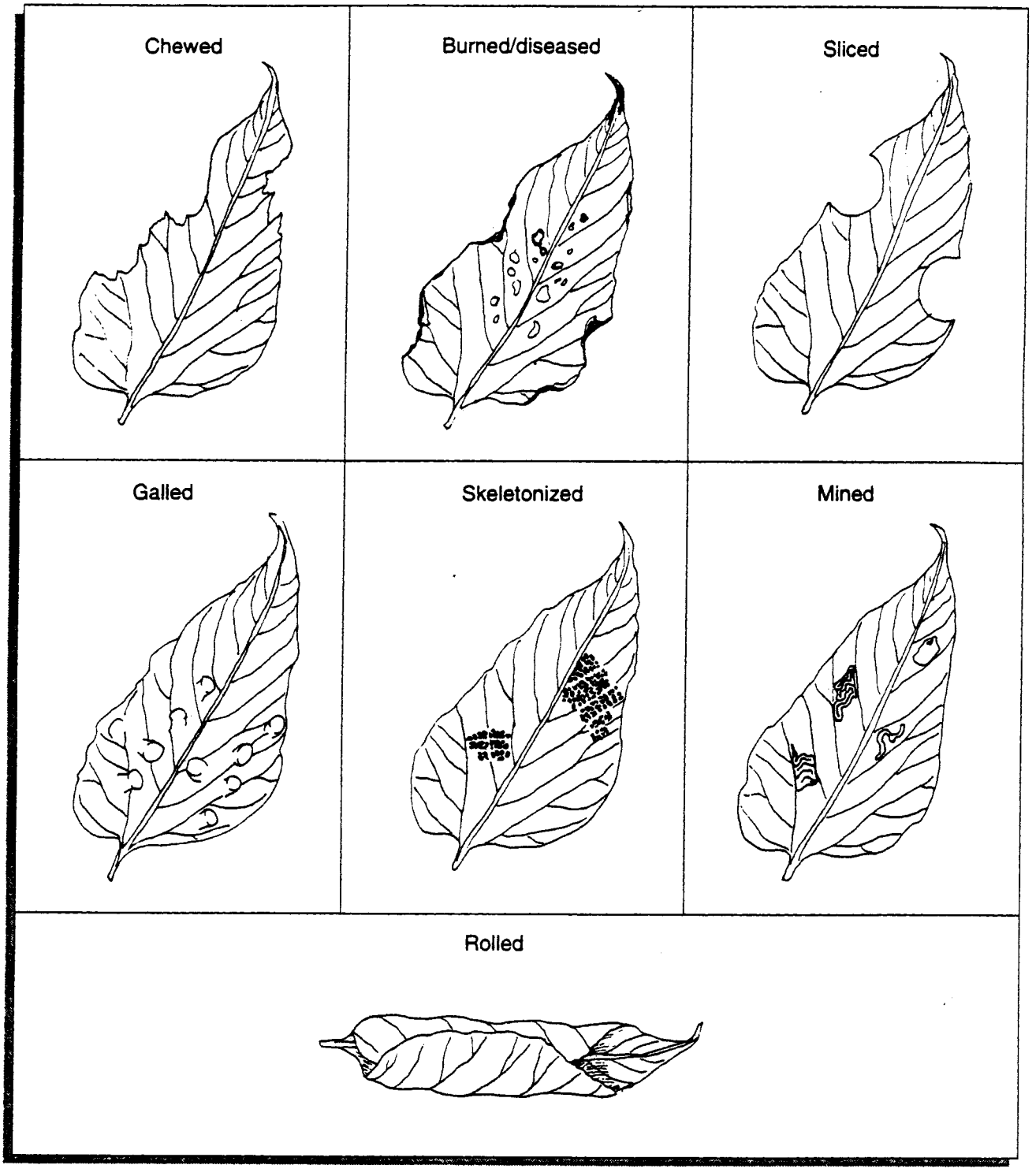
Tree Species	Hackberry

Tree Number	1		
Number of Leaves in Each Damage Class			
Chewed	8	Skeletonized	38
Mined	0	Galled	57
Rolled/Folded	7	Burned/Diseased	72
Sliced	0	Tattered/Intact	23

As mentioned above, notice that since a single leaf can have more than one type of damage, the total number is well over 100. Combine the results for all four or five trees into a summary giving the totals (including mean percentages in each damage class) for each tree species.

4. Utilize the same procedure and sample size for every tree you monitor.

Herbivore Damage Reference Card: Part 3, Protocol 2



Leaf Damage Tally Data Sheets: Part 3, Protocol 2

Date		Name	

Site Location	
County:	
Township Name:	
Township (ex. 12S):	
Range (ex. 4W):	
Section Number:	
Transect Letter	

Tree Species	

Tree Number			
Number of Leaves in Each Damage Class			
Chewed		Skeletonized	
Mined		Galled	
Rolled/Folded		Burned/Diseased	
Sliced		Tattered/Intact	

Tree Number			
Number of Leaves in Each Damage Class			
Chewed		Skeletonized	
Mined		Galled	
Rolled/Folded		Burned/Diseased	
Sliced		Tattered/Intact	

Tree Number			
Number of Leaves in Each Damage Class			
Chewed		Skeletonized	
Mined		Galled	
Rolled/Folded		Burned/Diseased	
Sliced		Tattered/Intact	

acid rain -- A type of rain that is produced when certain substances such as sulfur dioxide dissolve in rainwater resulting in increased acidity in the rain that may be harmful to organisms living where the rain falls.

acre -- A unit of area equal to 43,560 sq. feet or 0.405 hectares, approximately equal to a square measuring 209 ft. on a side.

alternate leaf -- A leaf arrangement resulting from 1 leaf per node so that one leaf appears on one side of the stem and the next leaf appears on the other side of the stem a little further up or down.

amphibian -- A vertebrate animal that usually has slimy, damp skin. It may adapted to living on land and/or in water. It may require land or water at different stages of its life. Example: a frog.

asymmetrical -- Arranged such that a line down the middle results in 2 parts that are unequal in size or shape. They are not mirror images of one another.

bearing -- A determination of position with respect to a compass, a heading.

biometrician -- A scientist who uses statistics in biology.

biometrics -- The use of statistics in biology.

butterflies -- A type of insect that has antennae with clubs or bulb-like structures on the ends of their antennae.

canopy -- The topmost layer of tree leaves in a forest.

Carabidae family -- ground beetles

census routes -- A set path or trail followed while surveying for insects. A census route is well-defined so that the census may be repeated in future years.

Cerambycidae family -- longhorned beetles

circumference -- The distance around the outer edge of a circle such as a tree trunk.

clay -- The smallest of three types of soil particles which originate from weathered rock. The others are sand and silt.

compound leaf -- A single leaf made up of many leaflets arranged in some way characteristic of the species. A compound leaf has a bud in the axis where the leaf meets the twig. The individual leaflets do not have buds where they meet the main stem of the leaf.

crown -- see tree crown.

defoliation -- The removal of the leaves on a plant.

density -- The number of plants in a given unit of area.

diameter -- The distance across the exact middle of a circle such as a tree trunk.

disturbance -- A natural or human-induced event that damages an ecosystem or some part of it, usually by the destruction of living material.

duff -- The layer of partially decomposed or newly fallen leaves and branches on the forest floor on top of the soil.

edge effect -- The influence of the outside environment on an ecosystem, particularly at the edge of an ecosystem that is directly exposed to a different environment. For example, the edge of a forest where it meets a field may be drier and hotter than the interior of a forest.

entire leaf -- A leaf without lobing.

estimate -- An educated guess.

exotic -- An organism that occurs in an area as a result of some human influence. In the Americas exotics are often defined as plants or animals that did not occur in the area before European settlement.

foliage -- A collective term for the leaves on a plant or group of plants.

hectare -- A metric unit of area equal to 2.47 acres, equal to a square measuring 100 m on a side.

herpetologist -- A scientist who studies reptiles and amphibians.

human impact -- The human influence on the rest of the natural world.

indicator species -- A species whose presence or absence in an ecosystem tells us something important about the ecosystem such as the presence of a rare orchid indicating a healthy forest.

indicators -- see indicator species

insect -- An invertebrate animal with an exoskeleton whose body is divided into head, thorax, and abdomen and usually has six legs.

invasive -- An aggressive exotic species that is particularly harmful to an ecosystem because it displaces significant numbers of native species.

land use -- The way in which an area of land is being used for human purposes such as agriculture.

leaf -- The green photosynthetic unit of a plant. May be simple or compound but always has a bud in the axis where the stem of the leaf meets the twig.

leaflet -- One of the components of a compound leaf. It may look like a simple leaf but it does not have a bud where the stem of the leaflet meets the stem of the leaf.

lobe -- One of many rounded protrusions along the margin of some leaves. A certain plant species would have a characteristic pattern of lobing. Example: maple leaves have lobes, beech leaves do not.

mean -- The average of a range of values.

Mecoptera order -- scorpion flies

microhabitat -- The specific home of a certain organism within a larger ecosystem, such as an ant colony in a tree within a large forest.

monitoring -- Measuring some aspect of a system in order to detect changes over time.

moths -- A type of insect, closely related to butterflies, which bears antennae that are pointed rather than clubbed.

mycelium -- The thread-like projections of fungi in the soil or duff. They often look like white threads running through the soil.

native -- An organism that evolved in an area. In the Americas natives are often defined as plants or animals that occurred in the area before European settlement.

non-native -- See exotic.

opposite -- A leaf arrangement resulting from 2 leaves per node so that the leaves are across from each other on the stem.

organic -- With respect to soil, the living or formerly living component including things like decomposing leaves and earthworms.

orienteer -- A person who uses a compass to determine direction.

ozone -- A type of oxygen molecule that occurs, among other places, in the atmosphere where it protects the earth by filtering out potentially damaging solar radiation.

perimeter -- The edge surrounding a given area.

prairie grove -- A relatively small forest existing along or near a river within the larger prairie biome.

prairie grove tree -- A tree that grew in a prairie grove environment. Prairie groves are generally more open and, consequently, prairie grove trees have more side branches and a full shape. If they are found in the center of a forest, it indicates that the forest has grown up around that tree and that the area used to be a prairie.

range -- indicates how far east or west in a state a township is located from a baseline. In Illinois, that baseline runs the length of the state and passes through Centralia.

regenerating -- The recovery of an ecosystem following some type of disturbance such as the clear-cutting of a forest.

reptile -- A vertebrate animal with dry and sometimes scaly skin. Example: a snake.

rotten -- A log that has begun decomposing or is well on its way to being decomposed so that it is spongy to the touch and may break apart easily.

salamander -- A type of amphibian with four legs and a tail.

sand -- The largest of the three types of soil particles which originate from weathered rock. The others are clay and silt.

sapling -- A young tree.

Scarabaeidae family -- scarab beetles

shrub -- A woody plant with numerous stems of relatively equal size as opposed to a tree with a single main trunk.

silt -- The second largest of the three types of soil particles which originate from weathered rock. the others are clay and sand.

simple leaf -- A single leaf that is not compound. Single leaves have only one blade and each leaf has a bud in the axis where the leaf meets the twig.

size class -- A division according to size. Tree are grouped into different classes according to size.

snake -- A type of reptile that crawls on its belly and has no limbs.

soil -- A substrate made up of an organic component and an inorganic component that is characterized as clay, sand, or silt.

soil profile -- A section through a given amount of soil showing its various layers.

stable -- A system that is not likely to change over time as a result of disturbance.

subcanopy -- A layer of tree leaves that exists below the canopy in the forest.

symmetrical -- Arranged such that a line down the middle results in 2 equal parts that are mirror images of each other.

Tabanidae family -- horseflies & deerflies

taxon/taxa -- Any unit of classification of a life-form such as family, genus, or species.

topographic -- Relating to topography.

topographic map -- A type of map that shows the topography of an area.

topography -- The physical characteristic of land, particularly the with variations in elevation.

township -- A political division of land which is square in shape and measures 6 miles on a side. Also, township refers to how far north or south in a state a political township is

located from a base line. In Illinois, the baseline runs the width of the state and passes through Centralia.

transect -- A straight line over some distance laid down so that some measurement may be taken along it.

trapping and baiting -- A method of trapping insects of a specific type by setting a trap with a bait known to attract that particular type of insect.

tree crown -- The uppermost branched, leafy part of a tree.

understory -- The plants growing on the forest floor beneath the canopy and subcanopy.

woody debris -- The litter of woody branches and twigs that have fallen to the forest floor.